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AD819854

RADC-TR-67-71, Volume II
Final Report

ACCELERATED TESTING OF HIGH RELIABILITY PARTS

T. Walsh
G. Bast

General Electric Company

TECHNICAL REPORT NO. RADC-TR- 67-71
June 1967

Rome Air Development Center
Air Force Systems Command
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ACCELERATED TESTING OF HIGH RELIABILITY PARTS

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SECTION 1

INTRODUCTION

This report is the final Technical Documentary Report of Contract AF30(602)-3968, Task 551902 and Project No. 5519.

The purpose of the program was to develop accelerated testing techniques for high reliability parts and to define long-term degradation mechanisms for these parts. The parts which were tested during the program are shown in Table 1-1 with the internal GE high reliability designation, the closest commercial designation, and the manufacturer.

Table 1-1. Description of Parts Tested

R NUMBER	DESCRIPTION	CLOSEST COMMERCIAL DESIGNATION
Resistors		
R2013	Ni Cr Metal Film, 1/8 Watt	XLT, IRC
R2048	Tin Oxide Film, 1/8 Watt	NF60, Corning
Capacitors		
R2045	Fixed Glass Dielectric	CYFR, Corning
Diodes		
R2008 P5, P10	Silicon, Regulator	IN751A, 752A, CDC
R2010 P1	Silicon, VHF	IN251, CDC
R2011 P1	Silicon, Computer	IN482A, CDC
Transistors		
R2004 P1	NPN, Silicon, 3 Watt	2N1613 FSC
R2005 P1	PNP, Silicon, 2 Watt	2N1132 FSC
R2026 P1	NPN, Silicon, 2 Watt	2N708 FSC
R2050 P1	NPN, Silicon, 4 Watt	2N657 FSC
R4041 P1	PNP, Silicon, 1 Watt	2N695 FSC

The parts under study were originally purchased for a reliability evaluation program during Project Advent (Contract AF04(647)-476). The reliability test and evaluation portion of the

project was initiated in 1960 to determine and specify procurement methods, screening techniques, and test and evaluation programs which would provide assurance that the hardware for the flyable satellites would meet the program objective of a 3-year life in a nonmaintainable space environment. Accelerated step-stress and constant stress tests were performed on electronic parts during the program to provide data and information which would lead to the formulation of design-life data, and screening tests. The test program continued until September, 1963 at which time the parts on life tests had accumulated 6000 to 10,000 hours each at various applied stresses and environmental conditions. The parts were then placed at storage conditions of 25° Celsius and zero power for ten months and were reactivated to the same prior test conditions for a 1 year period in June, 1964 as a requirement of contract AF 30(602)-3415. The step-stress tests which were completed during the Advent Program provided data which was analyzed during the initial period of the contract. The combination of the results of the step-stress tests and the constant stress tests formed the basis for the determination of the measurement techniques for controllable accelerated testing technique recommended as a result of the contract. The parts continued on Life Test during the period of June 65 to Dec 65 - the starting date for this one year contract (AF 30(602)-3968). The constant stress tests have accumulated 25,000 to 30,000 hours of test time and the step-stress tests were completed during the previous contracts. The tests were continued for a one year period to provide greater confidence in the test technique and to provide for further analysis of degradation trends.

The definition and establishment of accelerated testing methods and techniques for electronic parts must be based upon the actual failure mechanisms which exist in the part. Consequently this program consists of two distinct yet interrelated investigations. The first being the accelerated test program above and the second is the definition of the physical degradation mechanisms which the parts exhibit during the tests. Laboratory investigations were conducted on untested and on failed parts during the course of the program to identify the part failure mechanisms. In addition, a separate physics of failure investigation was instituted during this contract on inorganic dielectric capacitors.

The presentation of the accelerated testing concept, approach, and results are shown in Section 2. The results of the studies of the capacitor failure mechanisms are shown in Section 3 and the Summary and Conclusions are presented in Section 4. Appendix A provides a general description of the test and analysis activity. Volume II of this report contains the data from the constant stress tests together with charts of parameter trends.

NOTE

Unless otherwise indicated, C is an abbreviation for Celsius and not Centigrade.

SECTION 2

DESCRIPTION OF DATA FORMATS

The data in Section 3 contains information on the constant stress long life tests performed on resistors, capacitors, transistors, and diodes. Each page includes a graphic presentation of the average trend of the parts test data and a listing of any failures which occurred during test.

All charts reflect the accumulated test hours with the maximum, average, and minimum readings taken at each test time for the various parameters measured. Stress conditions, measurement conditions, and the parameters measured are noted on each figure. In addition to the accumulated test time, the time at which the parts were placed at storage conditions of 25 Celsius and zero power for ten months is shown.

The part type under test is shown at the bottom of each page.

All failures occurring during the test of each part type are indicated by the time of failure and frequency.

Additional information is available from the computer printout as follows:

a. Readings for each part at each test period by serial numbers.

b. Readings in ascending order of value (minimum to maximum) with serial numbers.

c. The change in reading between time periods for each serial number.

d. The change (percent) in reading from initial value.

e. The hours at which the change (percent) from initial value reaches the percentages indicated in the computer printout.

f. The natural logarithm of individual readings at each time period for each serial number.

Items a, c, d and f include a summary for each time period which gives the average value, standard deviation, minimum value, and maximum value. Items b, i and j were not included in previous computer printouts and have replaced the:

a. Sums of deltas for each part at each time period.

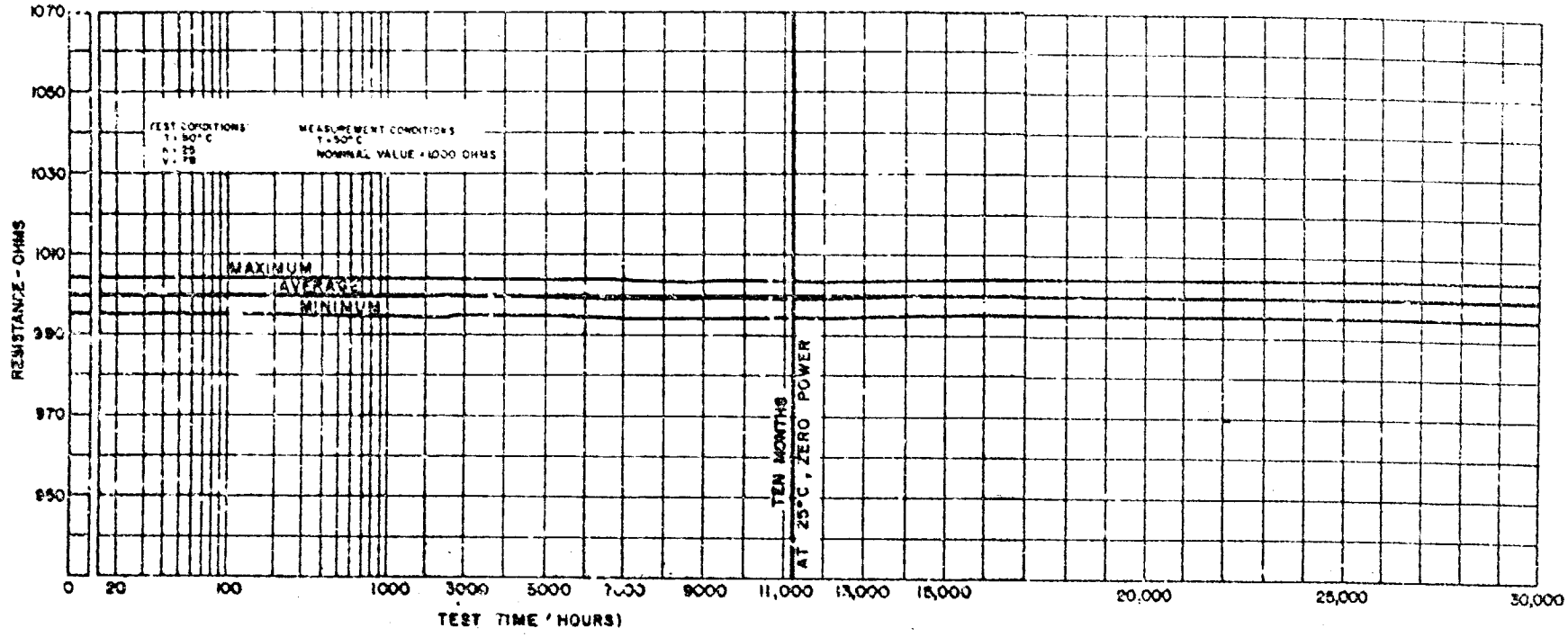
b. The absolute deltas for each part at each time period.

c. The absolute ratio for each part at each time period.

The raw data has been transferred to RADC for inclusion in the AF reliability central data system.

SECTION 3

DATA CHARTS



P/N R2016P1001

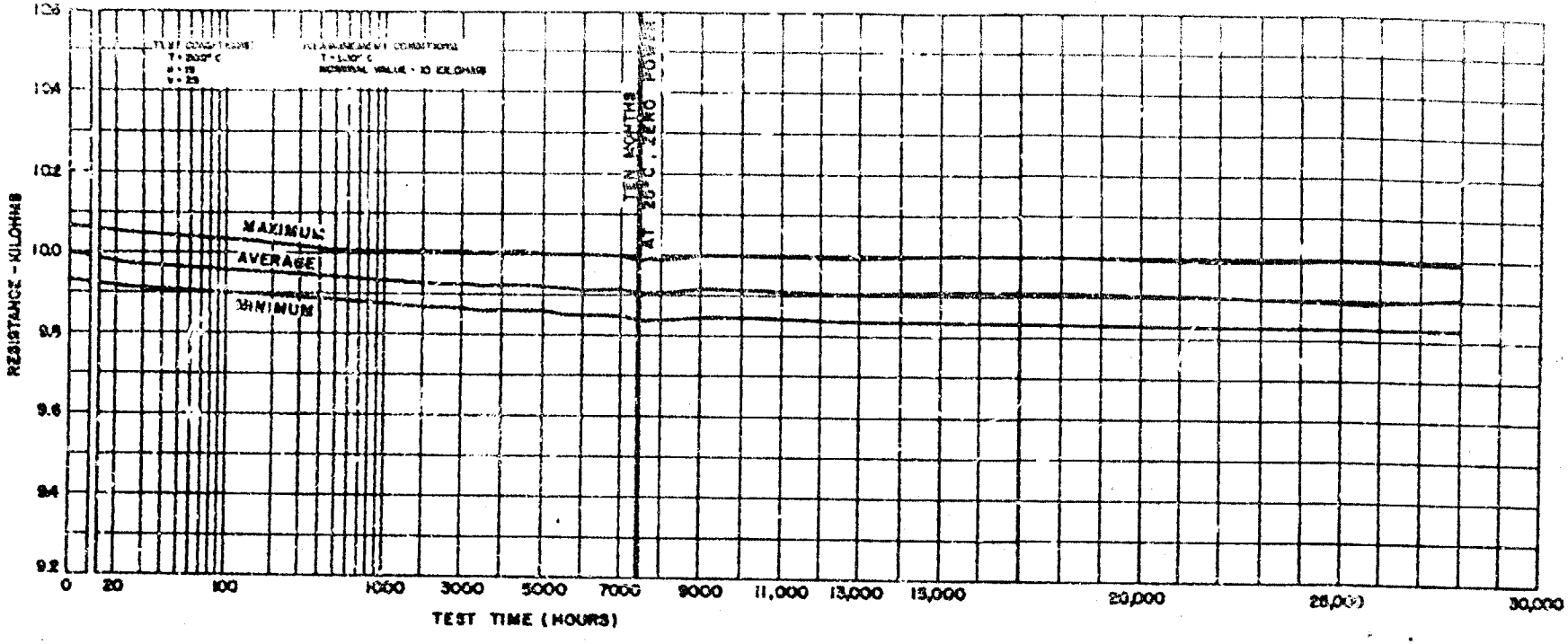
RESISTANCE VALUES IN OHMS

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0,	999,858	2.054	995,000	1004,100
96,	999,652	2.067	995,000	1004,100
168,	999,845	2.046	995,100	1004,100
504,	999,788	2.072	995,100	1004,200
1008,	999,844	2.102	995,000	1004,200
1680,	999,908	2.118	995,000	1004,200
2688,	999,768	2.084	995,000	1004,200
3360,	999,788	2.104	995,000	1004,100
4704,	999,848	2.094	995,000	1004,200
5448,	999,864	2.092	995,000	1004,200
6192,	999,888	2.088	995,000	1004,200
6936,	999,856	2.069	995,000	1004,100
7680,	999,864	2.058	995,000	1004,000
8423,	999,888	2.092	995,000	1004,200
9167,	999,860	2.092	995,000	1004,000
9911,	999,911	2.098	995,000	1004,000
10655,	999,715	2.118	994,800	1004,000
11399,	999,748	2.098	995,000	1004,000
11487,	999,724	1.955	995,000	1003,900
12631,	999,848	1.983	995,000	1003,900
13375,	999,718	1.959	995,000	1003,900
14269,	999,836	1.947	995,000	1003,900
15015,	999,828	1.953	995,000	1003,900
22414,	999,818	1.953	995,000	1003,900
27383,	999,832	1.961	995,100	1003,900
29869,	999,764	1.928	995,100	1003,900
32377,	999,849	1.939	995,100	1003,900

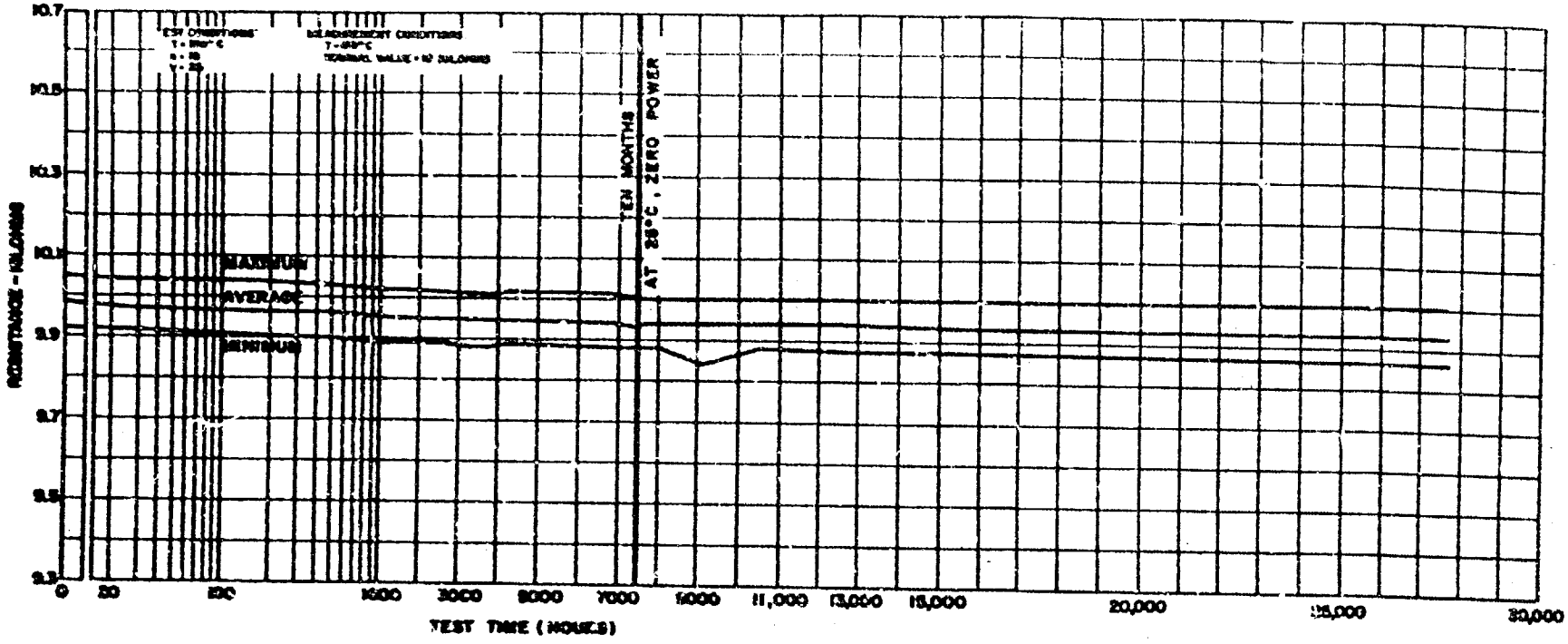
No Failures

Figure 3-1. R2016P1001 - Phase VI - Resistance Variation



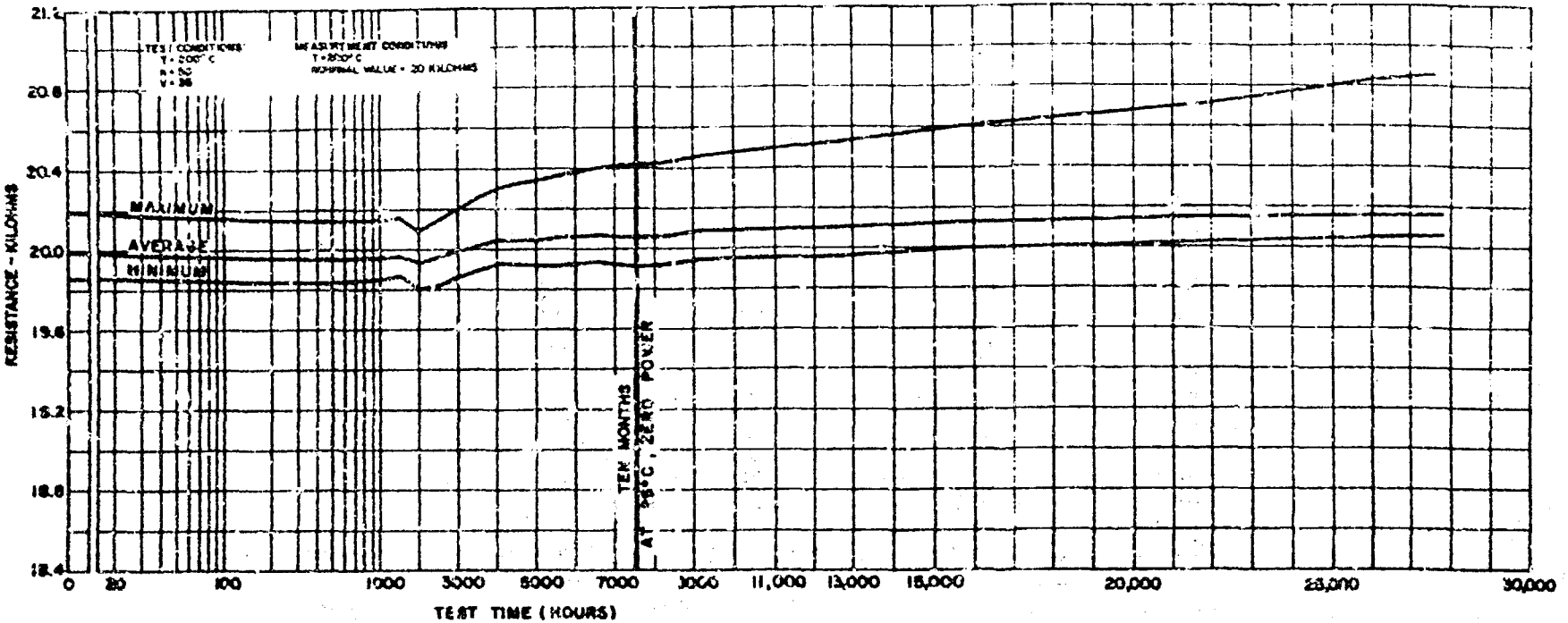
No Failures

Figure 3-2. R2016P1002 - Phase IV - Resistance Variation



0.	9.981	0.030	9.929	10.052
20.	9.976	0.030	9.924	10.046
100.	9.980	0.031	9.928	10.050
200.	9.983	0.031	9.931	10.054
1000.	9.978	0.031	9.926	10.049
1200.	9.976	0.032	9.923	10.046
3000.	9.980	0.032	9.928	10.051
3200.	9.982	0.032	9.929	10.052
5000.	9.982	0.032	9.929	10.052
5200.	9.980	0.032	9.926	10.049
6000.	9.978	0.032	9.923	10.046
6200.	9.980	0.032	9.926	10.049
7000.	9.980	0.032	9.926	10.049
7200.	9.978	0.032	9.923	10.046
8000.	9.980	0.032	9.926	10.049
8200.	9.978	0.032	9.923	10.046
9000.	9.980	0.032	9.926	10.049
9200.	9.978	0.032	9.923	10.046
11000.	9.980	0.032	9.926	10.049
11200.	9.978	0.032	9.923	10.046
13000.	9.980	0.032	9.926	10.049
13200.	9.978	0.032	9.923	10.046
15000.	9.980	0.032	9.926	10.049
15200.	9.978	0.032	9.923	10.046
20000.	9.980	0.032	9.926	10.049
20200.	9.978	0.032	9.923	10.046
25000.	9.980	0.032	9.926	10.049
25200.	9.978	0.032	9.923	10.046
30000.	9.980	0.032	9.926	10.049

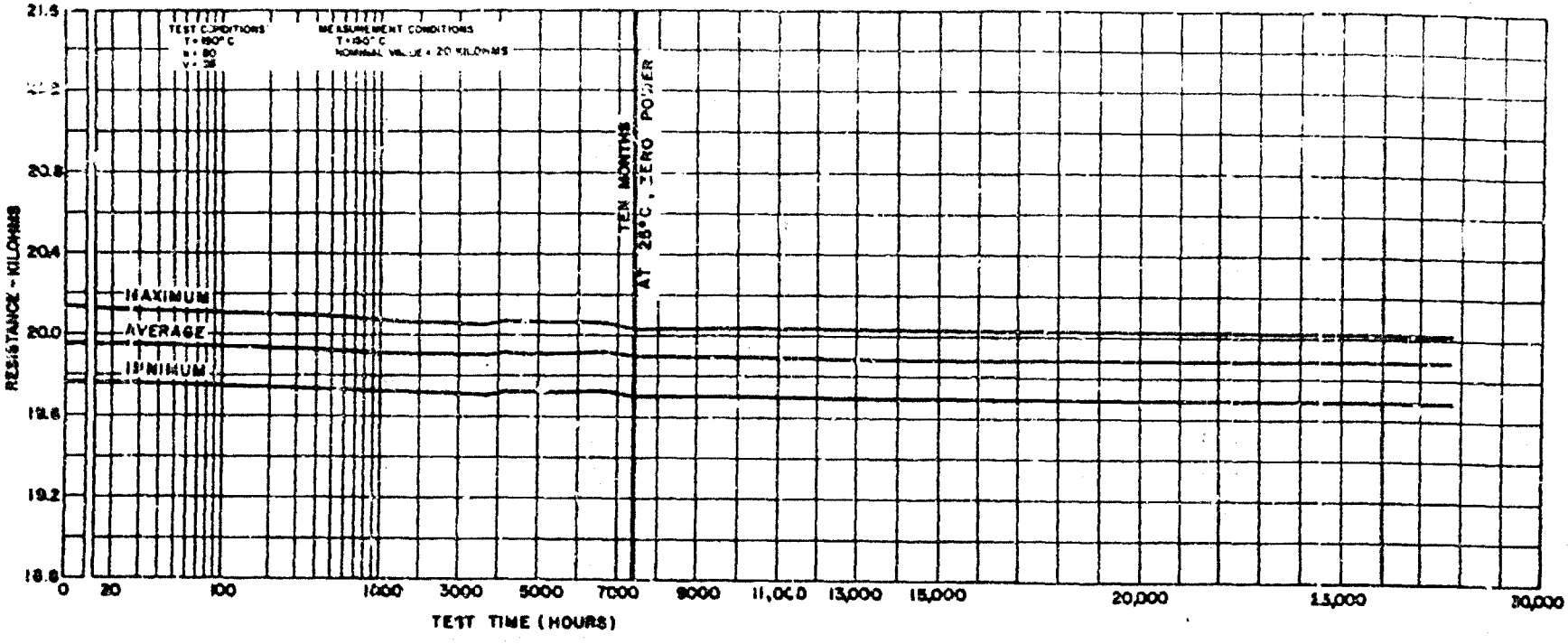
Figure 3-3. R2016P1002 - Phase V - Resistance Variation



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	19.989	0.074	19.865	20.105
24.	19.988	0.068	19.868	20.105
168.	19.957	0.065	19.839	20.143
504.	19.947	0.065	19.829	20.134
1008.	19.953	0.067	19.841	20.139
1509.	19.967	0.068	19.841	20.143
2511.	19.974	0.069	19.787	20.172
2520.	19.953	0.065	19.847	20.131
3528.	19.964	0.073	19.845	20.169
3529.	20.009	0.081	19.875	20.256
4008.	20.002	0.069	19.928	20.209
4529.	20.038	0.088	19.911	20.205
5025.	20.030	0.092	19.887	20.189
5527.	20.033	0.094	19.918	20.205
6032.	20.045	0.090	19.923	20.176
6512.	20.043	0.092	19.929	20.205
7032.	20.036	0.101	19.919	20.089
7548.	20.038	0.102	19.912	20.085
7716.	20.049	0.103	19.911	20.111
8058.	20.038	0.103	19.911	20.165
9154.	20.035	0.107	19.941	20.093
12554.	20.045	0.112	19.934	20.086
13025.	20.051	0.119	19.938	20.123
15996.	20.122	0.122	19.955	20.098
16996.	20.144	0.124	20.004	20.179
21793.	20.151	0.126	20.000	20.230
25987.	20.179	0.132	20.029	20.213
27965.	20.173	0.126	20.058	20.209

No Failures

Figure 3-4. R2016P2002 - Phase IV - Resistance Variation



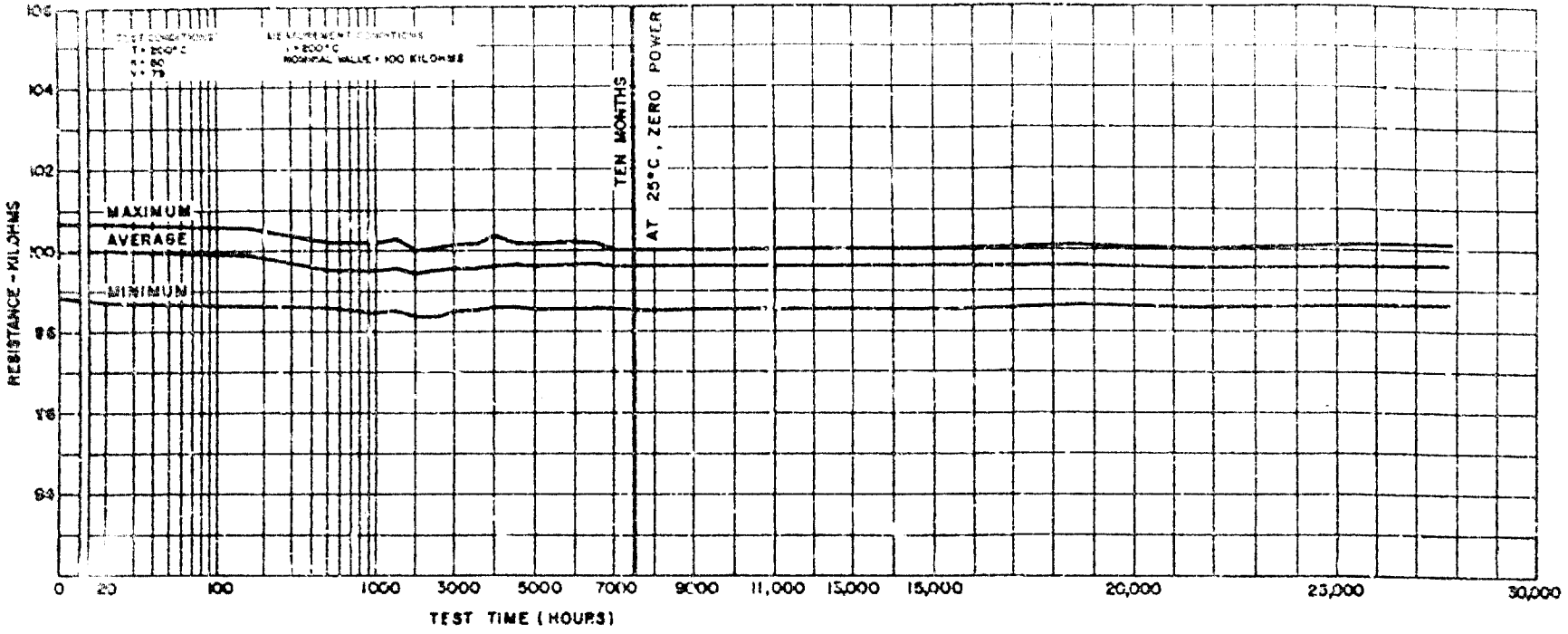
P/N 9 R2016P2002 — RESISTANCE VALUE - IN K OHMS

50 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	19,958	0.075	19,772	20.133
24.	19,956	0.066	19,763	20.130
168.	19,937	0,073	19,749	20.126
504.	19,927	0.081	19,738	20.090
1272.	19,914	0,090	19,725	20.076
1433.	19,912	0.086	19,724	20.069
2232.	19,909	0.089	19,719	20.065
2456.	19,908	0.088	19,718	20.063
3168.	19,904	0,089	19,718	20.072
3321.	19,904	0.083	19,727	20.068
4722.	19,918	0.089	19,725	20.067
4721.	19,914	0.088	19,721	20.062
5296.	19,913	0.088	19,721	20.061
5327.	19,914	0.088	19,721	20.061
6318.	19,918	0,089	19,724	20.064
6336.	19,916	0.088	19,727	20.064
7440.	19,893	0,085	19,707	20.039
7464.	19,893	0.084	19,708	20.037
7944.	19,894	0.086	19,707	20.039
8052.	19,896	0.087	19,709	20.044
10464.	19,899	0,087	19,709	20.041
10656.	19,897	0.087	19,708	20.038
11448.	19,897	0,087	19,708	20.039
11658.	19,895	0.086	19,707	20.036
21692.	19,891	0,085	19,708	20.039
25483.	19,893	0.086	19,707	20.038
27849.	19,893	0,084	19,709	20.038

No Failures

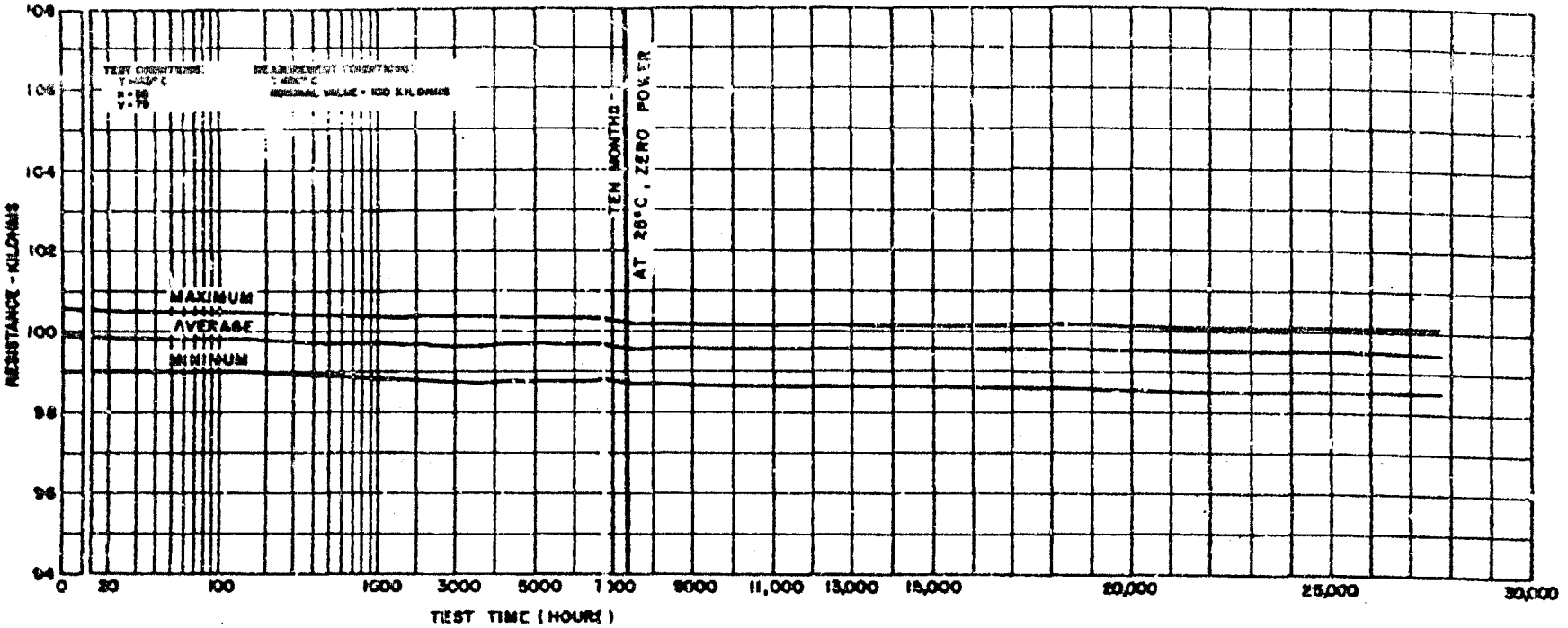
Figure 3-5. R2016P2002 - Phase V - Resistance Variation



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	100.042	0.072	99.849	100.210
24.	99.948	0.088	99.778	100.208
168.	99.837	0.089	99.690	100.000
504.	99.803	0.088	99.549	100.028
1008.	99.731	0.087	99.479	100.178
1512.	99.684	0.092	99.511	100.232
2011.	99.655	0.093	99.399	99.998
2688.	99.626	0.092	99.409	100.082
3008.	99.579	0.096	99.563	100.154
3511.	99.577	0.096	99.322	100.139
4008.	99.648	0.098	99.559	100.302
4515.	99.698	0.098	99.549	100.196
5012.	99.682	0.098	99.557	100.158
5512.	99.697	0.096	99.572	100.200
6012.	99.658	0.091	99.582	100.210
6512.	99.573	0.089	99.411	100.172
7012.	99.599	0.088	99.549	100.018
7512.	99.682	0.086	99.549	100.022
7716.	99.544	0.092	99.501	100.040
8078.	99.501	0.096	99.501	100.000
9153.	99.638	0.088	99.598	100.078
10578.	99.611	0.098	99.576	100.150
12578.	99.672	0.094	99.589	100.188
15578.	99.639	0.098	99.578	100.000
17578.	99.665	0.097	99.639	100.145
22752.	99.631	0.099	99.595	100.000
25007.	99.693	0.091	99.649	100.178
27865.	99.698	0.091	99.656	100.178

No Failures

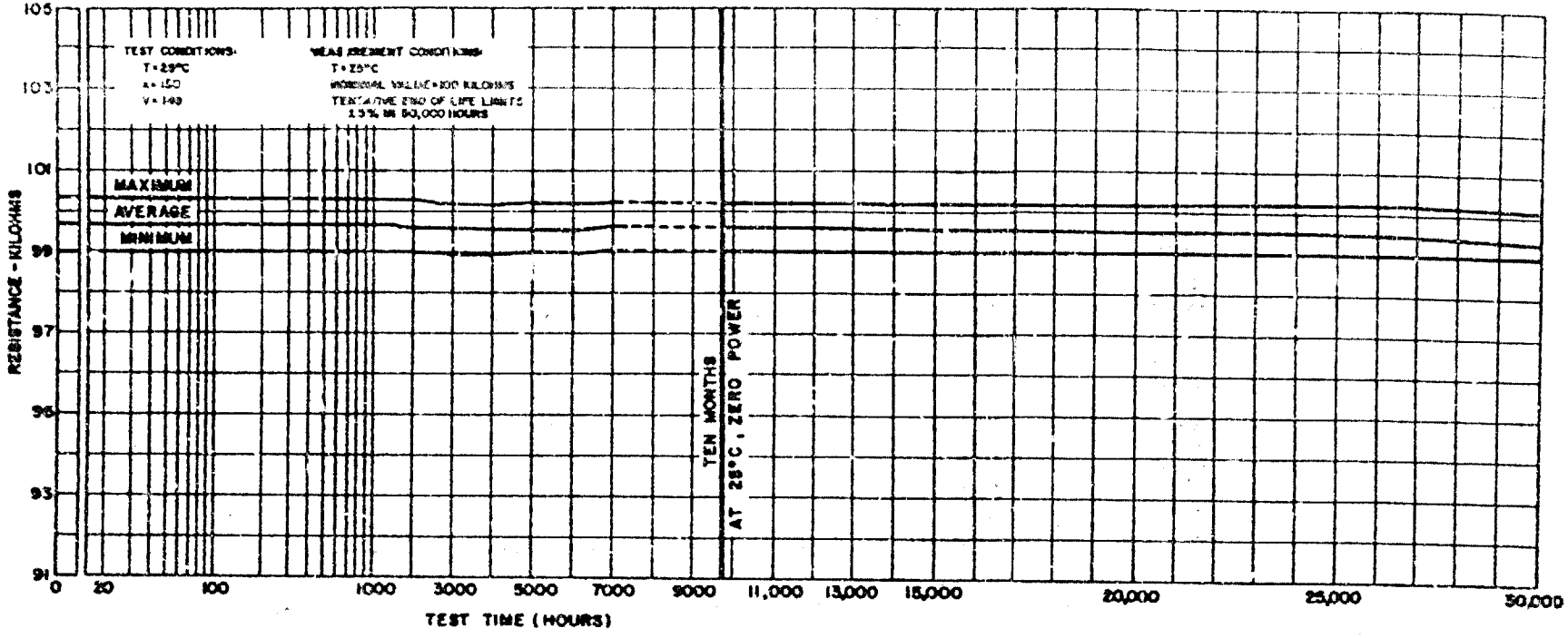
Figure 3-6. R2016P1003 - Phase IV - Resistance Variation



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	99.944	.389	99.000	100.648
24.	99.873	.388	98.944	100.800
168.	99.833	.361	99.000	100.518
504.	99.786	.363	98.889	100.470
1776.	99.720	.396	98.889	100.444
1776.	99.644	.4..	98.889	100.370
2232.	99.785	.355	98.833	100.400
2976.	99.688	.358	98.611	100.463
3576.	99.665	.330	98.796	100.296
3721.	99.665	.348	98.788	100.296
4224.	99.711	.334	98.839	100.370
4721.	99.716	.358	98.833	100.370
4776.	99.716	.336	98.889	100.348
4797.	99.716	.343	98.888	100.300
4896.	99.779	.328	98.891	100.319
4776.	99.744	.331	98.872	100.300
7464.	99.664	.343	98.796	100.218
7416.	99.626	.334	98.778	100.200
7944.	99.641	.341	98.796	100.200
8.56.	99.665	.348	98.788	100.218
14496.	99.631	.343	98.729	100.196
15456.	99.635	.344	98.778	100.200
15648.	99.673	.344	98.907	100.198
18456.	99.644	.343	98.784	100.200
21192.	99.669	.348	98.679	100.170
25656.	99.633	.338	98....	100.200
27888.	99....	.338	98.674	100.168

No Failures.

Figure 3-7. R2016P1003 - Phase V - Resistance Variation



AMBIENT LIFE R2016P1003

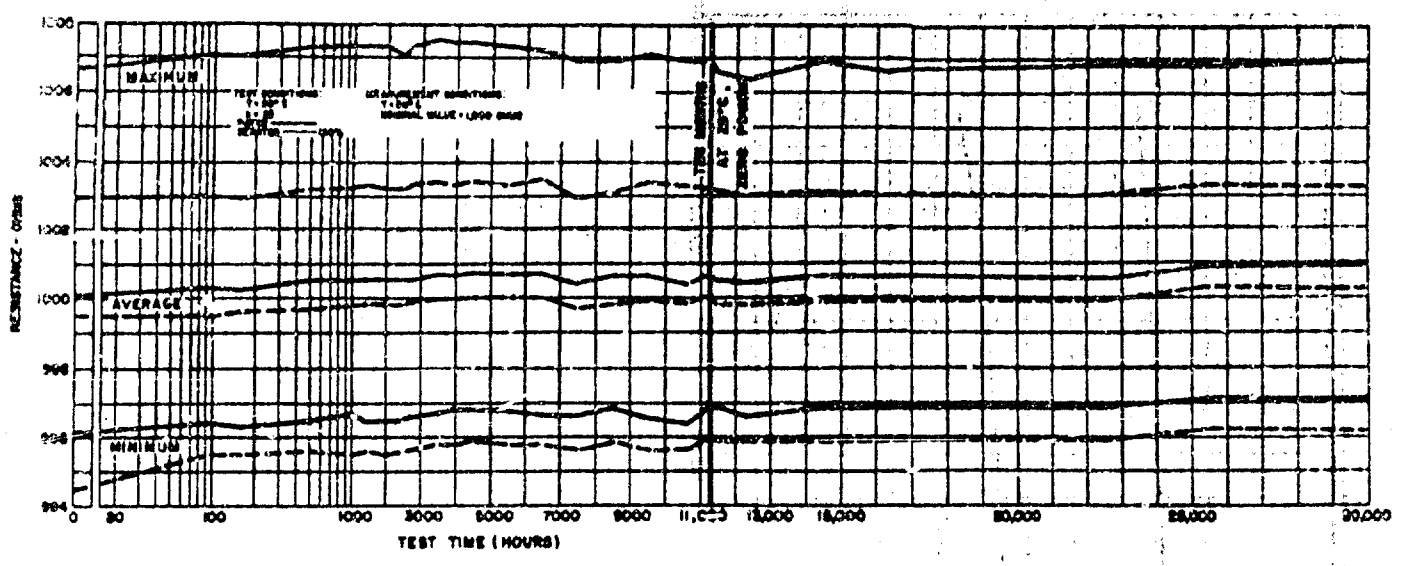
RESISTANCE VALUES IN K OHMS

140 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	99,886	0.269	99,038	100.296
24.	99,895	0.265	99,050	100.278
168.	99,848	0.261	99,039	100.256
352.	99,829	0.263	99,039	100.248
1000.	99,816	0.264	99,029	100.248
1336.	99,858	0.268	99,078	100.240
1504.	99,834	0.267	98,998	100.278
2014.	99,849	0.268	99,044	100.278
2759.	99,834	0.269	99,034	100.178
3824.	99,821	0.268	99,044	100.198
4681.	99,812	0.267	98,989	100.138
5020.	99,818	0.269	98,998	100.148
6255.	99,818	0.269	98,989	100.137
7016.	99,807	0.262	99,044	100.178
8777.	99,777	0.271	99,025	100.208
9776.	99,806	0.269	99,037	100.218
10007.	99,798	0.278	99,049	100.218
11498.	99,787	0.269	99,039	100.218
12797.	99,783	0.27	99,039	100.218
14036.	99,784	0.268	99,039	100.218
17493.	99,782	0.270	99,039	100.208
19431.	99,778	0.269	99,036	100.208
20007.	99,782	0.268	99,038	100.208
21018.	99,771	0.268	99,038	100.198
22001.	99,753	0.265	99,029	100.198

No Failures

Figure 3-8. R2016P1003 - Ambient Life - Resistance Variation



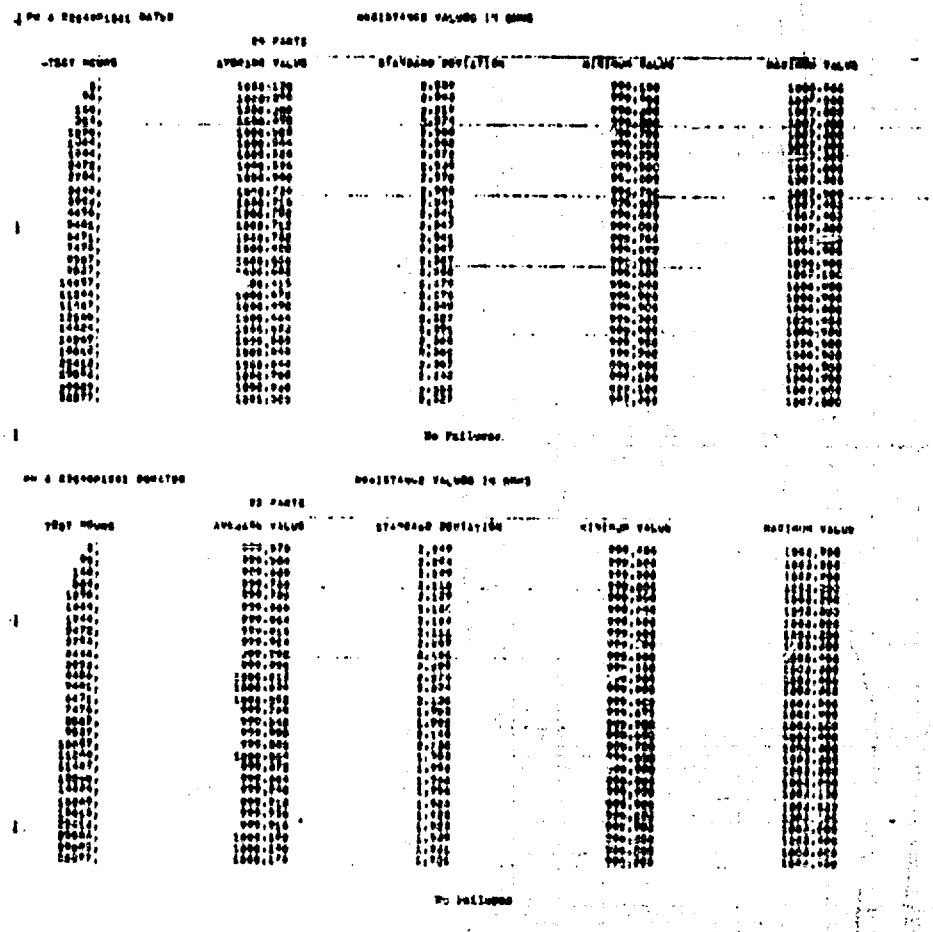
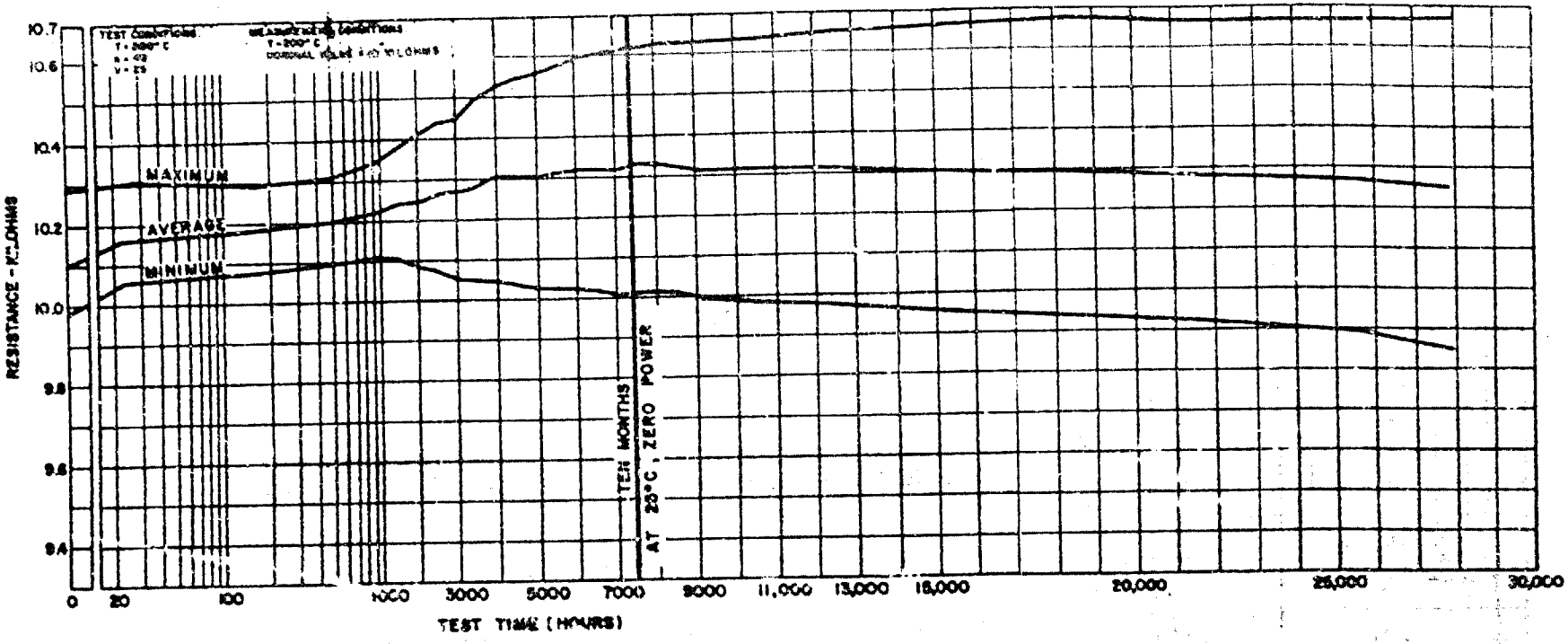


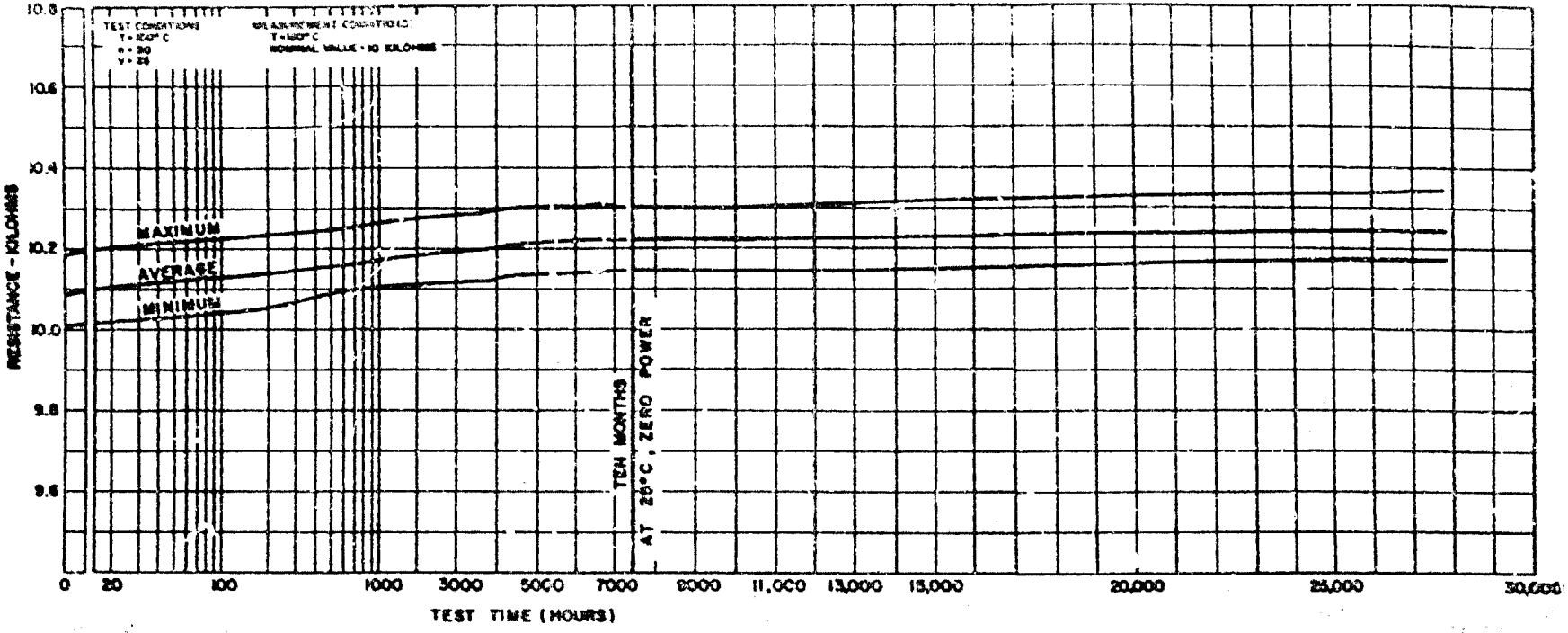
Figure 3-9. R2048P1001 - Phase VI - Resistance Variation



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	10.104	0.092	9.972	10.288
24.	10.155	0.058	10.034	10.302
168.	10.179	0.058	10.077	10.287
336.	10.156	0.063	10.063	10.263
1000.	10.219	0.065	10.107	10.344
1500.	10.233	0.072	10.106	10.338
2111.	10.243	0.077	10.096	10.402
2944.	10.256	0.085	10.076	10.438
3944.	10.267	0.093	10.050	10.461
5001.	10.306	0.108	10.046	10.504
6004.	10.303	0.108	10.045	10.529
6515.	10.306	0.113	10.044	10.548
7017.	10.303	0.110	10.076	10.527
7512.	10.310	0.123	10.023	10.528
8012.	10.310	0.120	10.021	10.598
8512	10.312	0.132	10.019	10.600
7977.	10.313	0.136	10.008	10.981
7958.	10.326	0.138	10.011	10.968
7710.	10.319	0.139	10.018	10.917
8058.	10.327	0.148	10.010	10.881
9151.	10.314	0.147	9.996	10.826
17944.	10.314	0.145	9.994	10.838
17954.	10.315	0.137	9.976	10.848
18544.	10.304	0.141	9.986	10.841
17954.	10.296	0.194	9.941	10.872
21754.	10.276	0.206	9.939	10.863
25507.	10.273	0.214	9.896	10.862
27344.	10.262	0.219	9.869	10.865

No Failures

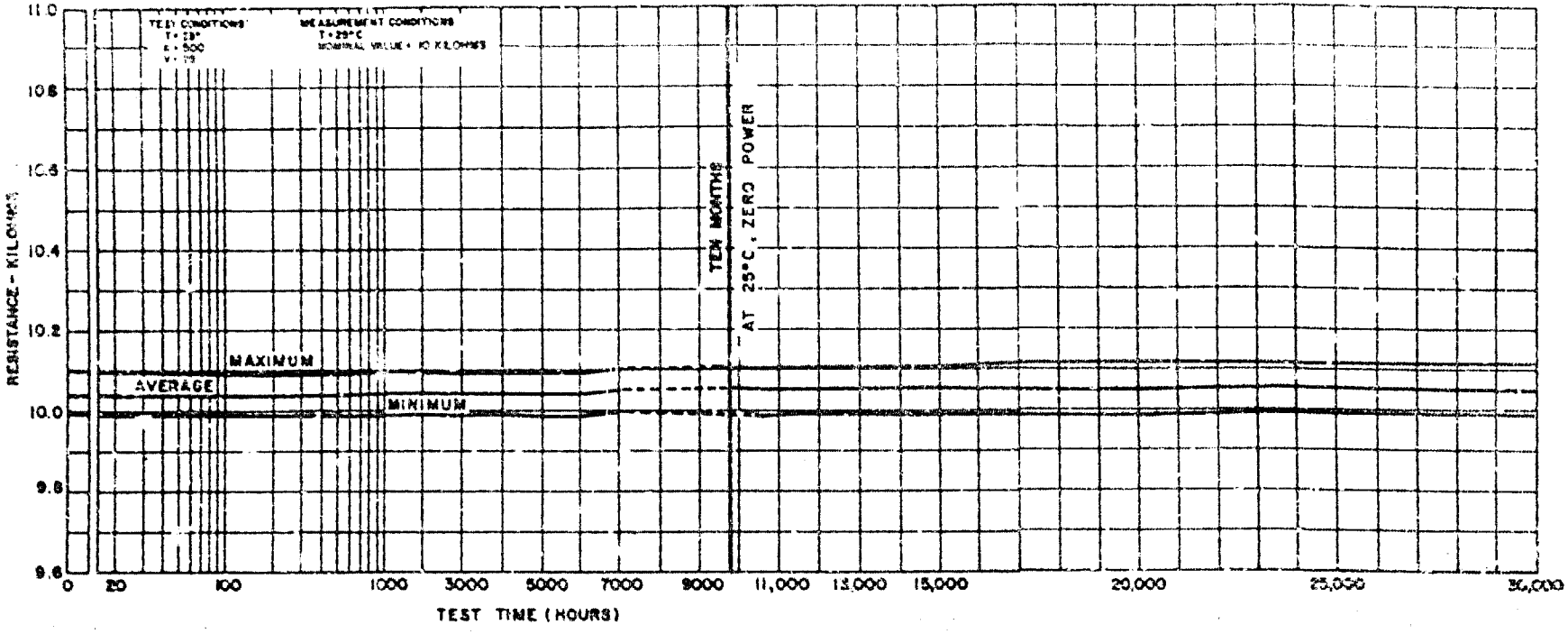
Figure 3-10. R2048P1002 - Phase IV - Resistance Variation



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	10.047	.038	10.012	10.102
94.	10.111	.038	10.076	10.206
144.	10.139	.033	10.067	10.214
324.	10.156	.032	10.091	10.214
1222.	10.175	.037	10.103	10.262
1732.	10.174	.036	10.106	10.264
2298.	10.143	.034	10.111	10.273
2696.	10.148	.034	10.114	10.236
3174.	10.141	.034	10.117	10.268
3324.	10.154	.033	10.118	10.264
4292.	10.158	.035	10.121	10.299
4721.	10.206	.036	10.132	10.292
5254.	10.217	.038	10.139	10.297
5727.	10.214	.038	10.137	10.300
6319.	10.219	.039	10.141	10.304
6834.	10.226	.038	10.144	10.310
7451.	10.219	.039	10.142	10.299
7819.	10.219	.040	10.140	10.302
7951.	10.222	.039	10.145	10.303
8654.	10.216	.038	10.143	10.305
8745.	10.221	.038	10.144	10.307
9654.	10.225	.038	10.148	10.314
10444.	10.222	.040	10.151	10.320
10854.	10.234	.040	10.160	10.321
11692.	10.245	.039	10.162	10.326
12673.	10.243	.038	10.162	10.323
12951.	10.249	.038	10.167	10.329

No Failures

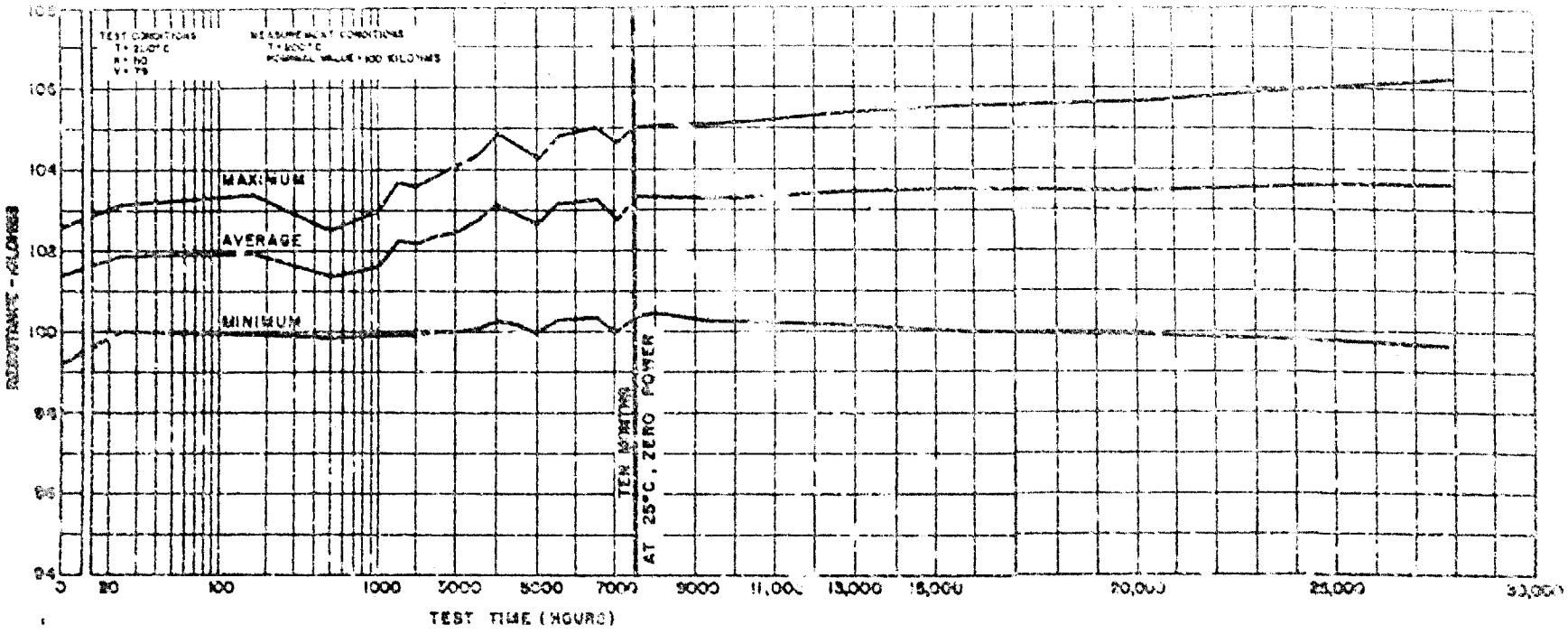
Figure 3-11. R2048P1002 - Phase V - Resistance Variation



Test Hours	Average	Maximum	Minimum
0	10.030	9.994	10.064
24	10.030	9.996	10.066
168	10.030	9.997	10.061
552	10.040	9.989	10.094
1004	10.041	9.987	10.096
1536	10.042	9.994	10.096
1584	10.042	9.994	10.098
2016	10.041	9.993	10.098
2520	10.038	9.995	10.091
3024	10.038	9.993	10.091
4032	10.039	9.994	10.093
5040	10.038	9.996	10.093
6936	10.038	9.994	10.092
7936	10.040	9.997	10.103
9797	10.052	9.992	10.109
9974	10.050	9.990	10.104
10307	10.050	9.989	10.106
11290	10.051	9.994	10.106
13797	10.053	9.998	10.108
14938	10.054	9.993	10.109
17493	10.054	9.993	10.113
20331	10.053	9.992	10.109
23097	10.054	9.991	10.109
26710	10.056	9.995	10.109
30031	10.052	9.994	10.109

No Failures

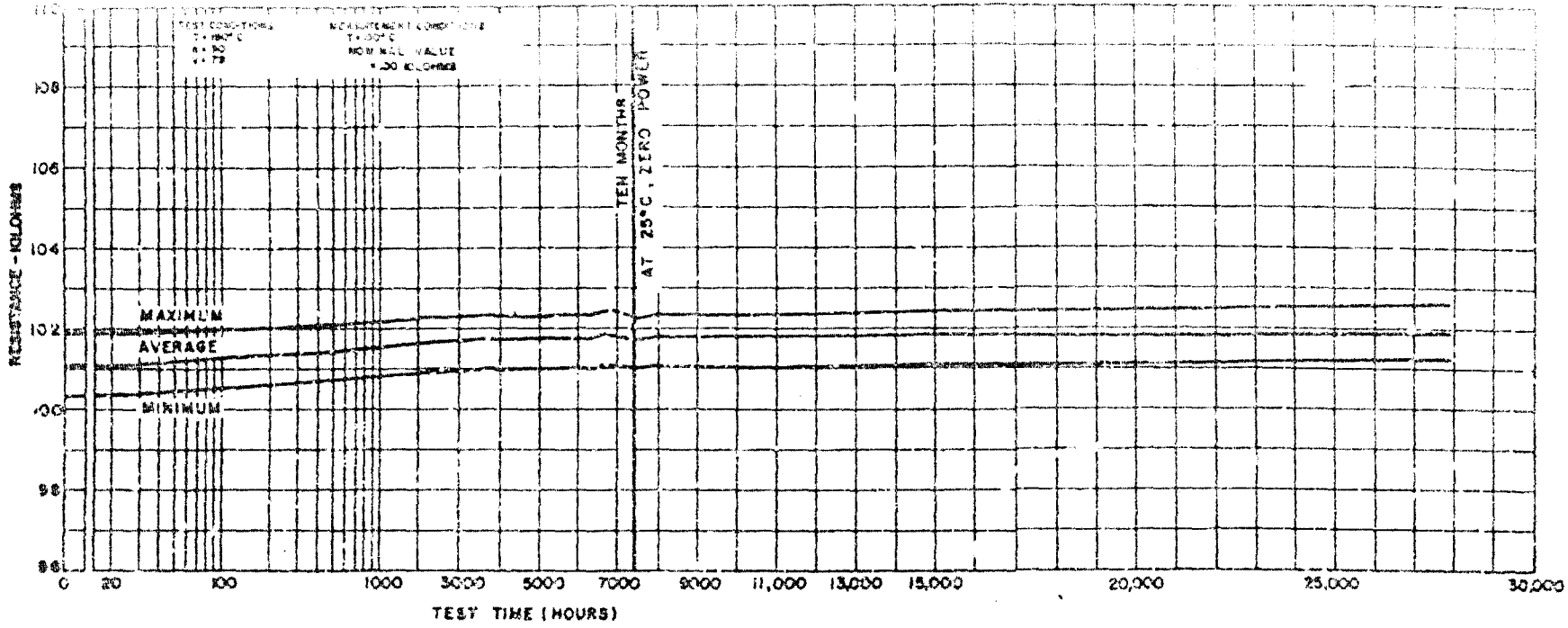
Figure 3-12. R2048P1002 - Ambient Life - Resistance Variation



PHASE 4 REQUIREMENTS — RESISTANCE VALUES IN K OHMS

49 PARTS

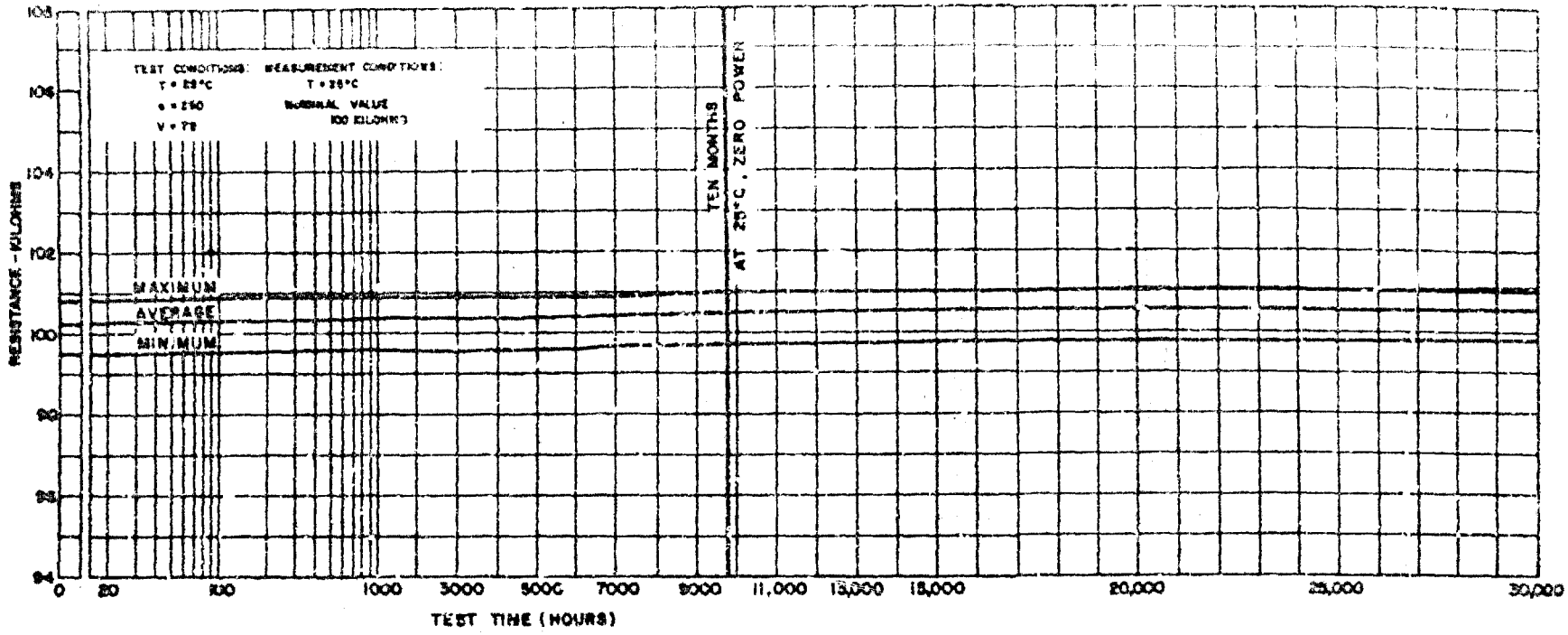
TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	101.365	0.597	99.[illegible]	102.910
20.	101.449	0.642	[illegible]	[illegible]
100.	101.485	0.564	99.952	102.980
500.	101.382	0.561	98.820	102.570
1000.	101.660	0.703	97.968	103.260
3000.	102.281	0.768	99.873	103.840
5000.	102.150	0.769	99.[illegible]18	103.590
7000.	102.358	0.[illegible]	99.[illegible]66	[illegible]
9000.	102.[illegible]	0.[illegible]	99.919	104.[illegible]
11000.	102.[illegible]	0.[illegible]	[illegible]	[illegible]
13000.	103.[illegible]	0.[illegible]	100.328	104.[illegible]18
15000.	102.985	1.[illegible]	[illegible]	104.590
20000.	102.493	1.[illegible]	99.598	104.193
25000.	103.[illegible]	1.[illegible]	[illegible]	[illegible]
30000.	103.224	1.[illegible]	101.[illegible]8	[illegible]
[illegible]	[illegible]	1.[illegible]	[illegible]	[illegible]
70[illegible].	102.770	1.[illegible]	[illegible]	[illegible]
75[illegible].	103.[illegible]	1.[illegible]	[illegible]	[illegible]
77[illegible].	103.[illegible]	1.[illegible]	[illegible]	[illegible]
80[illegible].	103.242	1.[illegible]	[illegible]	[illegible]
81[illegible].	103.[illegible]	1.[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
85[illegible].	103.[illegible]	1.[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
88550.	[illegible]	[illegible]	[illegible]	[illegible]
91750.	[illegible]	[illegible]	[illegible]	[illegible]
93[illegible].	103.[illegible]	1.[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	101.143	0.403	100.388	101.829
24.	101.191	0.414	100.338	101.868
168.	101.350	0.378	100.626	102.018
504.	101.423	0.365	100.788	102.126
1176.	101.554	0.425	100.958	102.188
1512.	101.605	0.426	101.086	102.226
2352.	101.686	0.406	100.930	102.298
2856.	101.672	0.383	100.826	102.288
3192.	101.736	0.425	100.994	102.338
3528.	101.714	0.432	101.020	102.354
4032.	101.770	0.434	100.998	102.378
4368.	101.751	0.388	101.048	102.345
4704.	101.764	0.399	101.078	102.349
5208.	101.798	0.391	101.090	102.438
5544.	101.769	0.391	101.098	102.409
6216.	101.874	0.434	101.238	102.452
6552.	101.784	0.421	101.070	102.388
7056.	101.741	0.423	101.058	102.352
7392.	101.746	0.421	101.049	102.389
7728.	101.742	0.455	101.030	102.378
8064.	101.770	0.441	101.048	102.398
8568.	101.837	0.438	101.188	102.424
8904.	101.846	0.448	101.180	102.438
9240.	101.816	0.442	101.196	102.488
9744.	101.896	0.442	101.146	102.488
10080.	101.896	0.444	101.308	102.556
27441.	101.972	0.453	101.240	102.588

No Failures

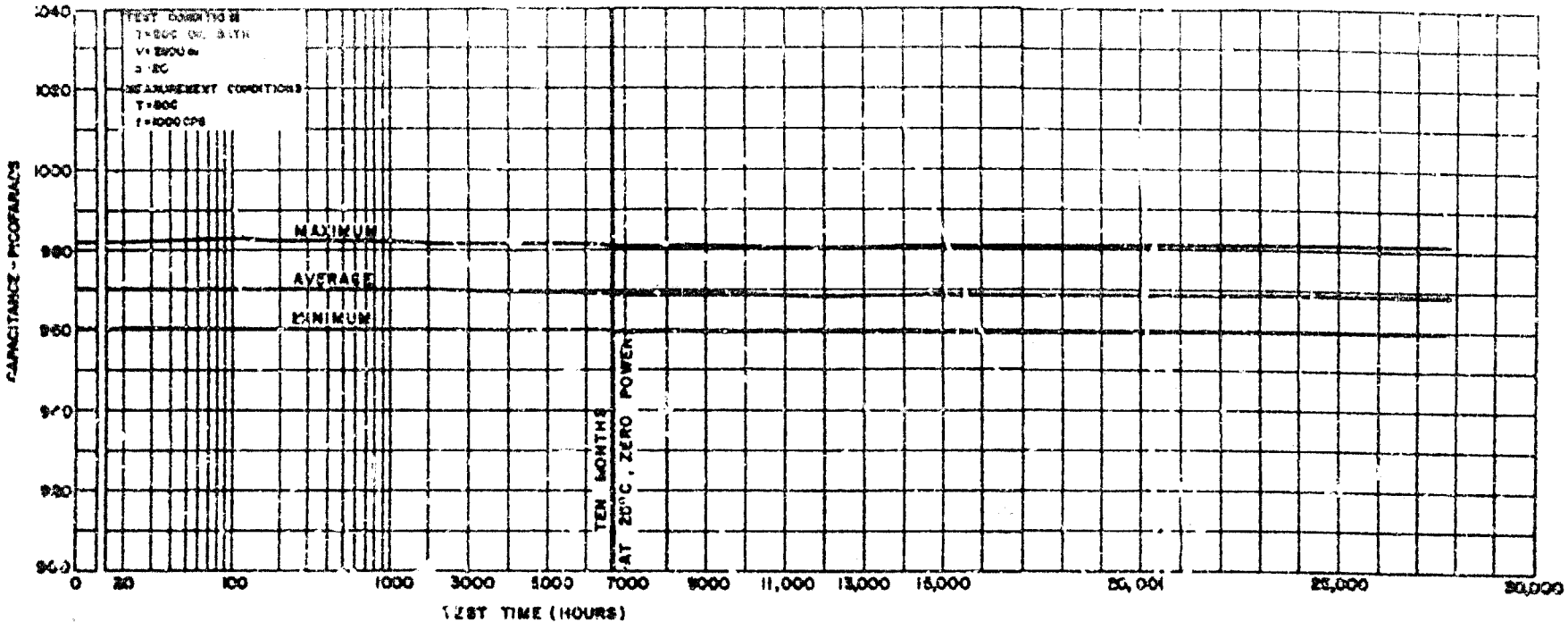
Figure 3-14. R2048P1033 - Phase V - Resistance Variation



Test Hours	Average	Minimum	Maximum
0	100.308	99.880	102.870
24	100.307	99.870	102.304
168	100.300	99.869	100.868
332	100.306	99.897	100.920
1004	100.301	99.819	100.900
1508	100.401	99.825	100.940
1844	100.401	99.824	100.920
2436	100.403	99.818	100.908
2520	100.307	99.863	100.718
3004	100.306	99.886	100.910
4031	100.307	99.865	100.910
5003	100.414	99.813	100.920
5833	100.405	99.905	100.930
7336	100.402	99.730	100.906
8737	100.502	99.100	101.060
9974	100.506	99.723	101.060
10307	100.500	99.731	101.030
11859	100.571	99.731	101.080
12797	100.504	99.782	101.060
13830	100.512	99.754	101.060
17068	100.508	99.700	101.060
20331	100,576	99.781	101.090
23697	100.567	99.765	101.090
26810	100.583	99.787	101.080
30041	100.583	99.787	101.100

No Failures

Figure 3-15. R2048P1003 - Ambient Life - Resistance Variation



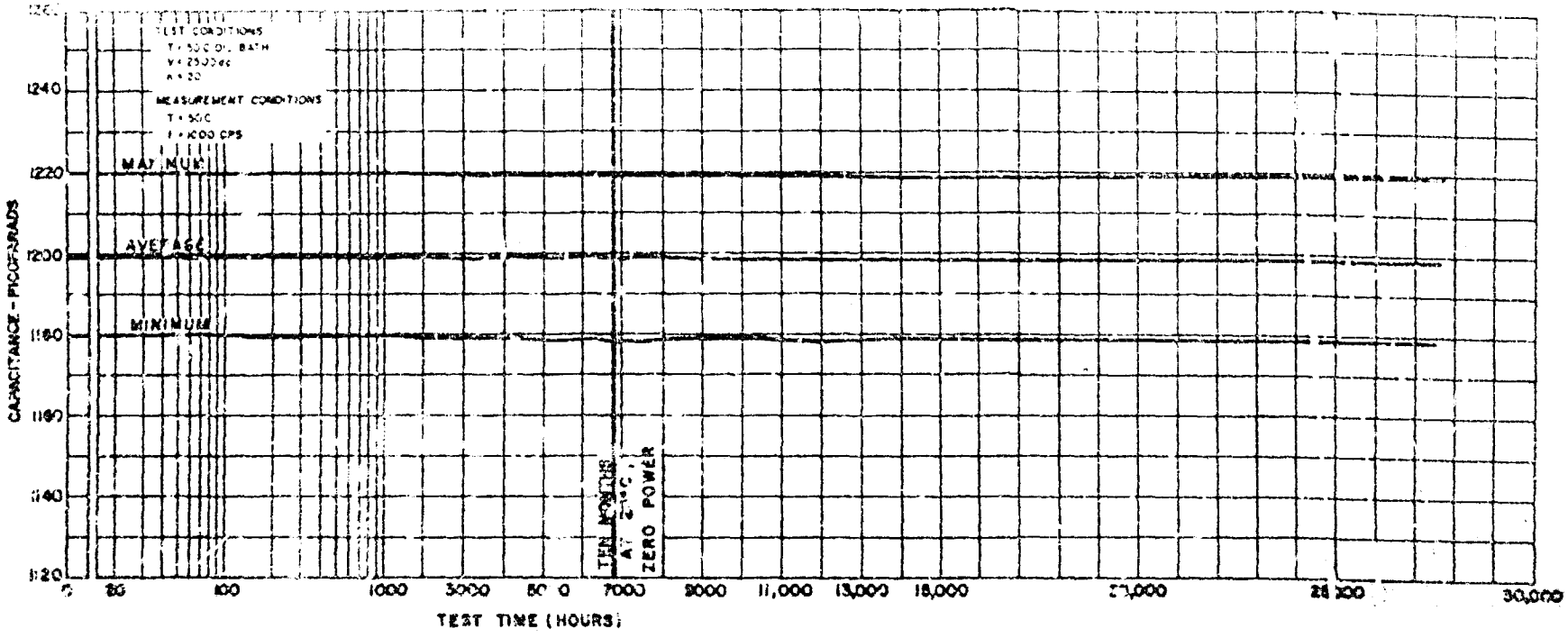
CAPACITANCE VALUES IN MMF

11 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	969.889	7.188	946.660	983.117
24.	965.964	7.180	941.692	982.238
96.	969.144	7.164	943.640	982.427
168.	965.273	7.184	944.796	982.554
192.	969.987	7.166	944.928	982.254
336.	965.988	7.158	941.588	982.153
1008.	968.936	7.179	940.966	981.847
1344.	965.944	7.183	940.788	981.844
1512.	968.468	7.187	941.182	981.854
1680.	964.184	7.188	940.948	981.845
2352.	968.118	7.197	939.688	981.848
3024.	967.866	7.208	938.668	981.888
3192.	967.999	7.187	940.488	981.888
3360.	968.883	7.201	942.488	981.858
3528.	967.959	7.194	940.488	981.838
3696.	967.772	7.218	940.788	981.888
11172.	967.918	7.187	940.968	981.868
17688.	967.771	7.189	940.788	981.888
17856.	967.898	7.194	942.868	981.838
21864.	967.881	7.864	944.888	981.788
22032.	967.987	7.189	944.988	981.888
22200.	967.992	7.188	944.888	981.888

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
0	116	1
	896	1
	21872	2
	21904	6

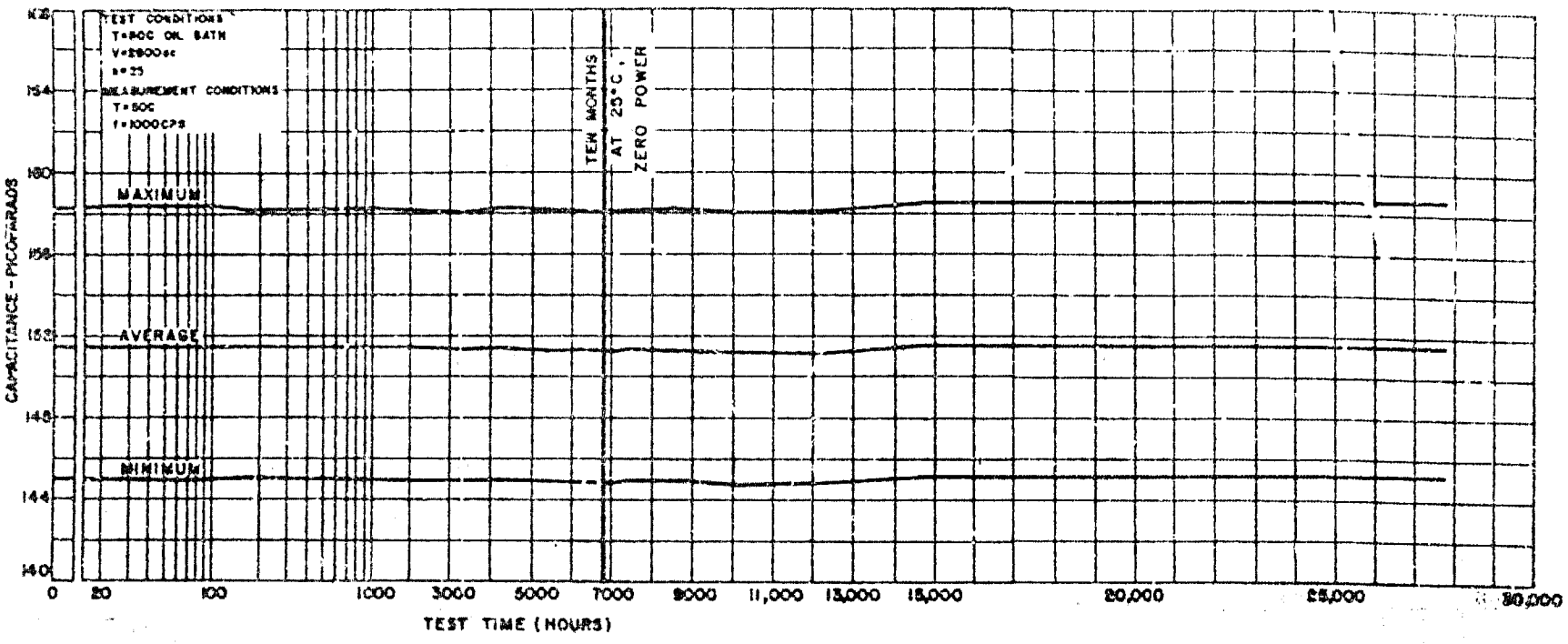
Figure 3-16. R2045P102 - Phase IV - Capacitance



PH 4 R2045P122A	CAPACITANCE VALUES IN MMF			
	11 PARTS			
TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	1203.136	15.496	1181.000	1216.000
24.	1203.955	15.479	1181.000	1217.000
65.	1198.045	15.564	1180.000	1217.000
113.	1200.182	15.552	1180.000	1217.000
162.	1199.909	15.518	1180.000	1217.000
331.	1199.955	15.458	1180.000	1217.000
2013.	1199.409	15.496	1180.000	1217.000
2259.	1199.182	15.618	1179.000	1217.000
4271.	1199.318	15.618	1179.000	1217.000
5268.	1199.273	15.791	1179.000	1217.000
9278.	1199.409	15.729	1180.000	1217.000
9554.	1199.591	15.434	1179.000	1217.000
7810.	1199.727	15.732	1179.000	1217.000
7953.	1199.364	15.645	1180.000	1217.000
8393.	1199.364	15.767	1179.000	1217.000
9965.	1199.136	15.884	1179.000	1217.000
11497.	1199.909	15.876	1179.000	1218.000
13866.	1199.591	15.729	1179.000	1218.000
17954.	1199.409	15.739	1180.000	1217.000
19345.	1199.318	15.804	1180.000	1217.000
21719.	1199.045	15.815	1179.000	1218.000
21724.	1199.000	15.798	1179.000	1218.000

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
0	21692	0

Figure 3-17. R2045P122A, Phase IV - Capacitance

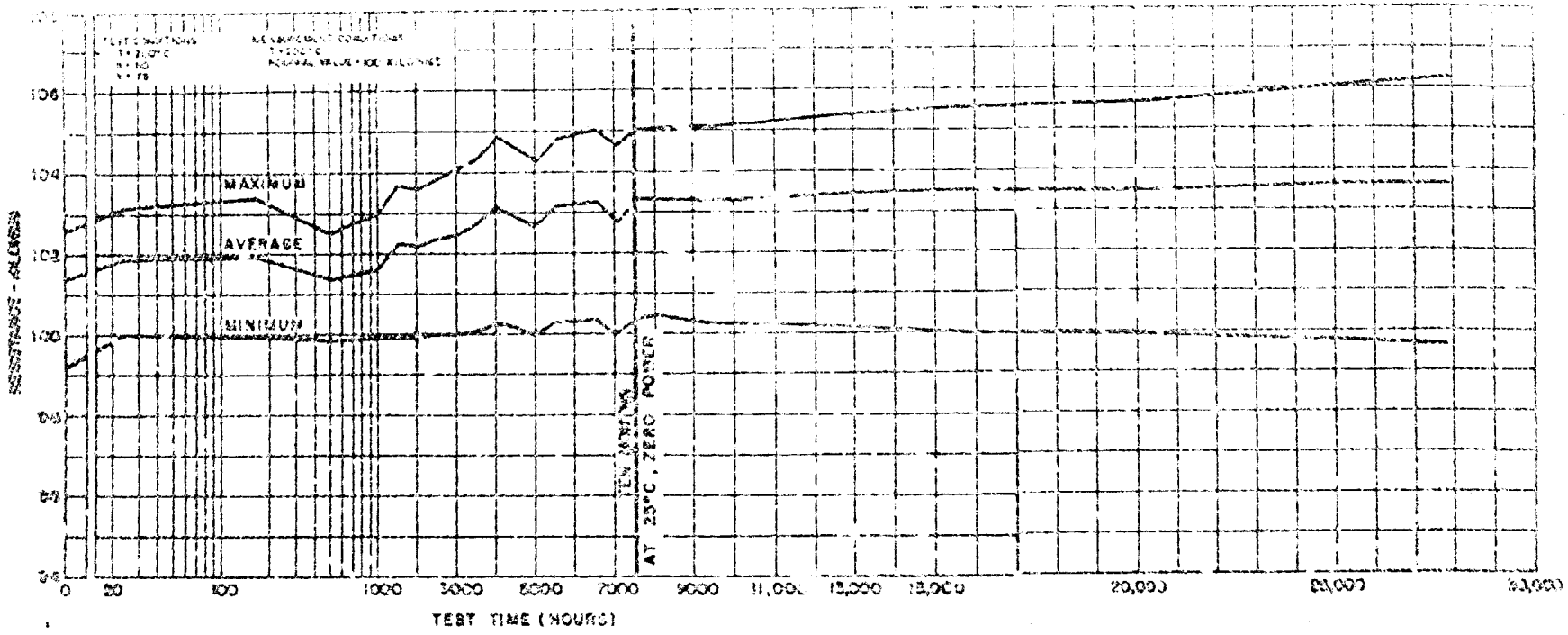


Pn # R2045P151 — CAPACITANCE VALUES IN MMF — 25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	151.366	2.913	148.000	158.364
24.	151.870	2.922	148.000	158.400
96.	151.900	2.920	148.000	158.400
168.	151.878	2.920	148.000	158.400
192.	151.744	2.884	148.000	158.284
274.	151.878	2.922	148.000	158.388
2832.	151.424	2.933	144.000	158.284
3264.	151.364	2.934	144.000	158.388
4271.	151.448	2.916	148.000	158.388
5040.	151.366	2.918	144.000	158.388
5376.	151.360	2.902	144.000	158.388
6054.	151.344	2.917	144.000	158.388
7010.	151.344	2.926	144.000	158.284
7392.	151.488	2.899	148.000	158.388
8880.	151.360	2.911	148.000	158.388
9864.	151.378	2.918	148.000	158.388
11832.	151.384	2.904	148.000	158.284
14568.	151.888	2.912	148.000	158.400
17904.	151.848	2.904	148.000	158.400
21312.	151.824	2.917	148.000	158.400
24624.	151.848	2.909	148.000	158.400
27734.	151.918	2.914	148.000	158.364

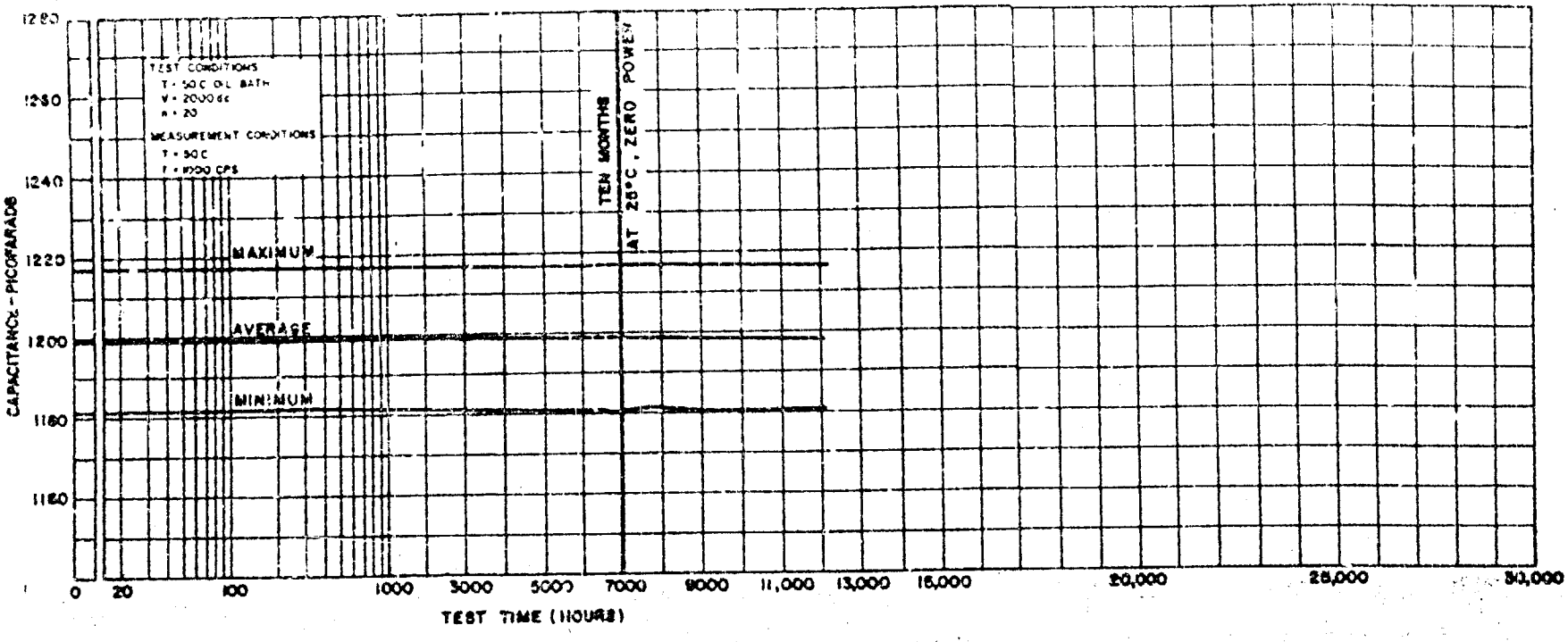
No Failures

Figure 3-18. R2045P151 - Phase IV - Capacitance



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	101.365	0.497	99.[illegible]	102.810
24.	101.849	0.844	[illegible]	[illegible]
168.	101.935	0.766	99.65[illegible]	103.910
503.	101.952	0.843	99.[illegible]	[illegible]
1184.	101.843	0.733	[illegible]	103.210
1504.	102.261	0.769	99.[illegible]	[illegible]
2011.	102.159	0.769	99.[illegible]	103.970
2504.	102.358	0.[illegible]	99.[illegible]	[illegible]
3001.	102.[illegible]	0.[illegible]	99.970	104.[illegible]
3504.	[illegible]	0.[illegible]	[illegible]	[illegible]
4184.	102.[illegible]	0.[illegible]	100.[illegible]	104.[illegible]
4519.	102.605	0.[illegible]	100.[illegible]	104.[illegible]
5012.	102.693	0.[illegible]	99.[illegible]	104.[illegible]
5512.	103.151	0.[illegible]	[illegible]	[illegible]
6017.	103.274	0.[illegible]	[illegible]	[illegible]
6504.	103.338	0.[illegible]	[illegible]	[illegible]
7004.	102.778	0.[illegible]	[illegible]	[illegible]
7496.	104.363	0.[illegible]	[illegible]	[illegible]
7992.	103.353	0.[illegible]	[illegible]	[illegible]
8504.	103.342	0.[illegible]	[illegible]	[illegible]
9184.	103.278	0.[illegible]	[illegible]	[illegible]
9504.	104.163	0.[illegible]	[illegible]	[illegible]
10000.	103.487	0.[illegible]	[illegible]	[illegible]
10496.	103.558	0.[illegible]	[illegible]	[illegible]
10992.	103.[illegible]	0.[illegible]	[illegible]	[illegible]
11504.	103.[illegible]	0.[illegible]	[illegible]	[illegible]
12184.	103.736	0.[illegible]	[illegible]	[illegible]
12504.	104.[illegible]	0.[illegible]	[illegible]	[illegible]

Figure 3-18. [illegible] - Phase IV - Resistance Isolation



P= 5 R2045P122A — CAPACITANCE VALUES IN MMF

14 PARTS

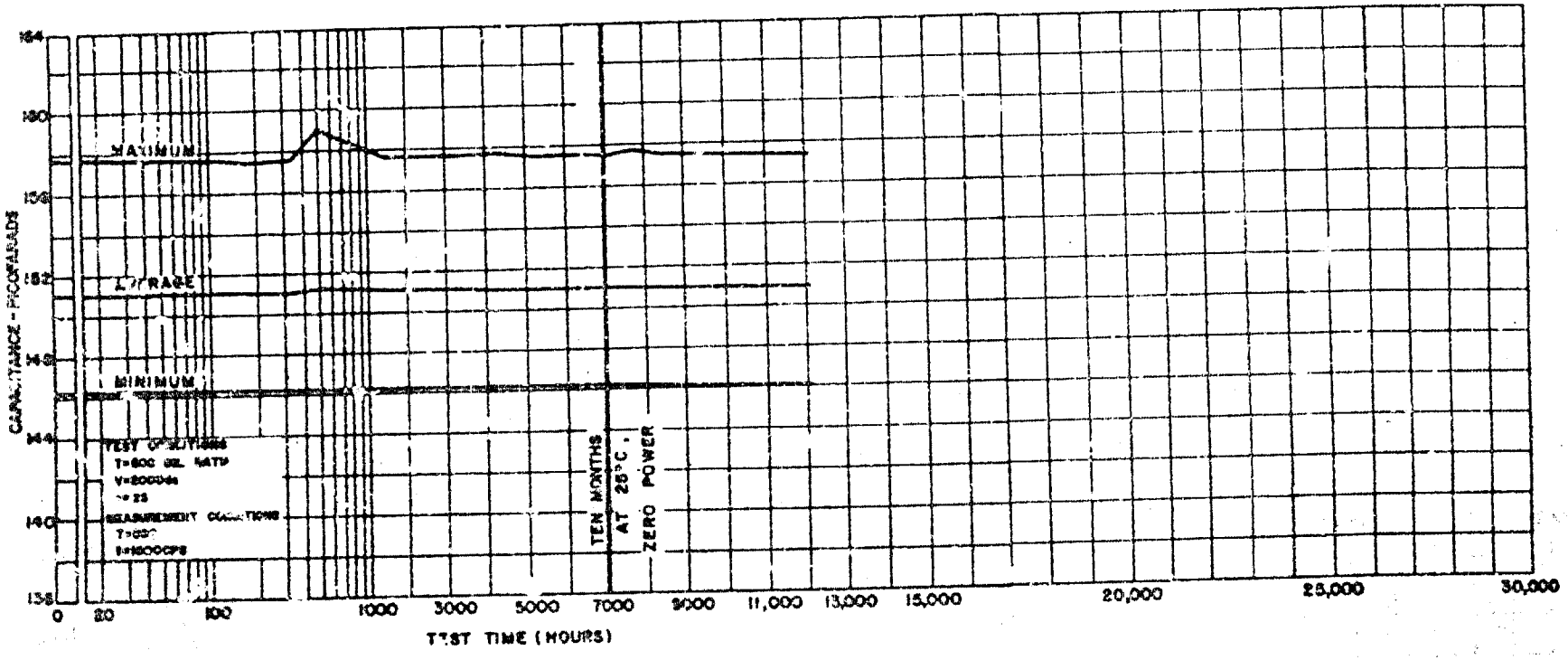
TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	1199.953	18.738	1182.000	1217.938
25.	1197.516	18.681	1182.000	1217.938
114.	1199.422	18.717	1182.000	1217.938
193.	1199.578	18.689	1182.000	1217.969
331.	1199.836	18.689	1182.000	1217.969
491.	1199.805	18.686	1182.000	1217.938
1497.	1199.422	18.674	1181.906	1217.938
2986.	1199.344	18.669	1181.906	1217.938
3149.	1199.211	18.673	1181.906	1217.938
4271.	1199.156	18.736	1181.688	1217.938
5298.	1199.078	18.734	1181.594	1217.938
6179.	1199.152	18.688	1181.906	1217.938
7071.	1198.766	18.747	1181.688	1217.938
7236.	1199.008	18.787	1181.594	1217.938
7900.	1198.242	18.763	1182.000	1217.969
8163.	1199.047	18.733	1181.906	1217.969
8817.	1198.969	18.799	1181.500	1217.969
12029.	1198.492	18.681	1181.688	1216.688

TOTAL FAILURES: 1

TIME TO FAILURE (HRS): 24

QUANTITY: 1

Figure 3-20. R2045P122A - Phase V - Capacitance



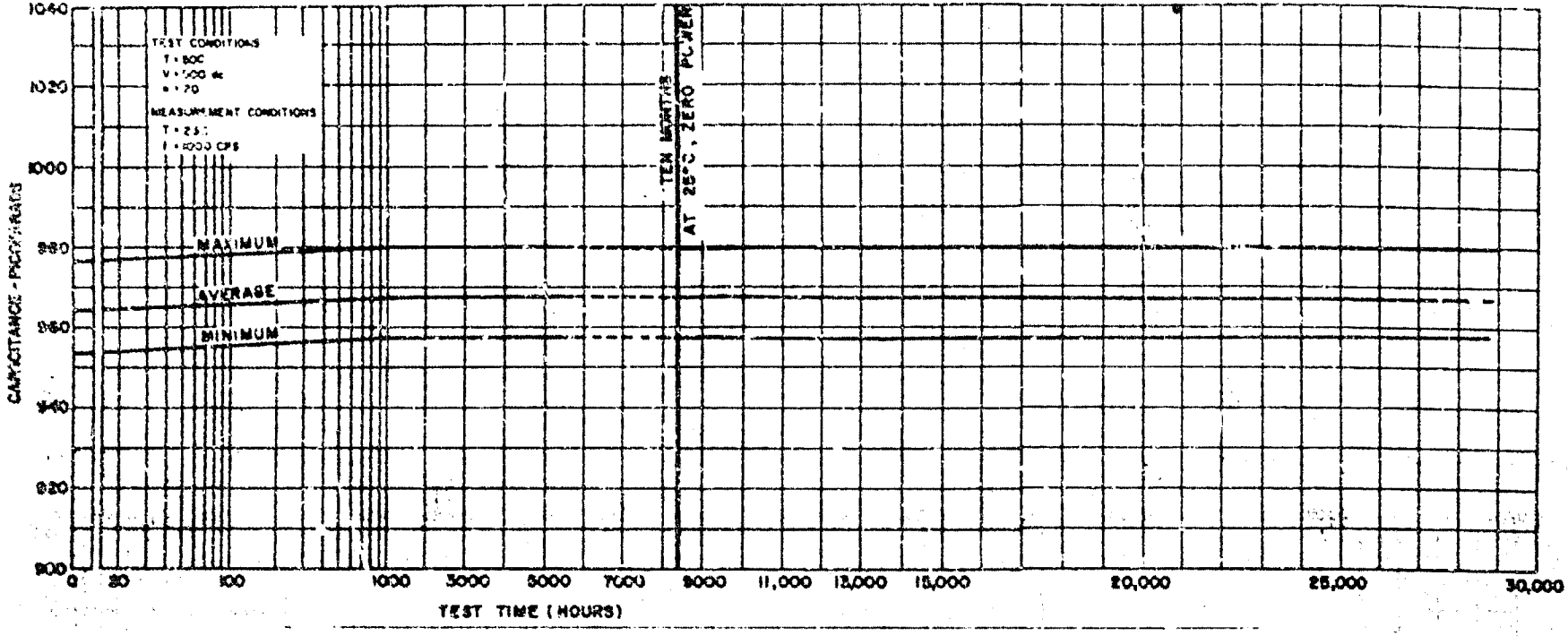
PN 5 R2045P191 — CAPACITANCE VALUES (in mmf)

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	151.872	2.796	148 388	157.668
24	151.833	2.764	146.288	157.568
116	151.839	2.768	146.788	157.588
168	151.854	2.774	146.788	157.588
231	151.848	2.781	146.188	157.588
484	151.844	2.818	146.188	157.588
1497	151.872	2.777	146.288	157.568
2004	151.838	2.764	146.288	157.568
3067	151.814	2.784	146.288	157.568
4374	151.868	2.788	146.288	157.488
5990	151.848	2.754	146.288	157.488
6539	151.814	2.788	146.288	157.488
7871	151.844	2.791	146.188	157.488
7824	151,872	2.777	146.288	157.488
7904	151,838	2.783	146.288	157.568
8549	151,844	2.727	146.188	157.488
10176	151,848	2.799	146.188	157.488
12586	151.868	2.778	146.188	157.568

No Failures

Figure 3-21. R2045P151 - Phase V - Capacitance



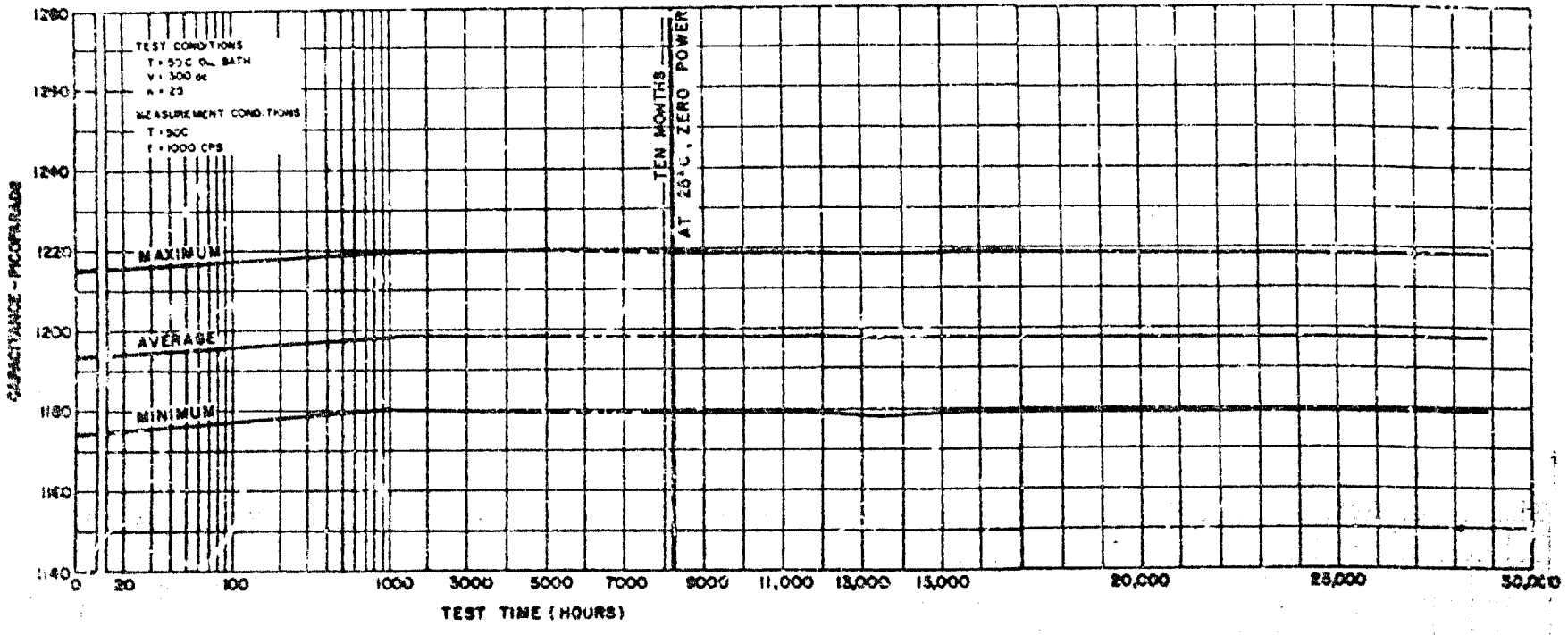
CAPACITANCE VALUES IN MMF

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	967.792	6.605	957.500	980.188
1000.	967.788	6.627	957.988	979.988
1988.	967.840	6.624	957.500	980.000
4192.	967.828	6.621	957.788	979.988
9012.	967.648	6.611	957.488	979.888
8384.	967.644	6.727	957.188	979.188
9478.	967.860	6.653	957.188	979.388
9784.	967.488	6.619	957.488	979.488
11407.	967.824	6.656	957.888	979.638
11784.	967.112	6.638	956.788	979.188
13481.	967.712	6.647	957.388	979.388
13672.	966.828	6.638	956.888	978.963
2206.4.	966.892	6.635	956.688	978.888
20314.	966.928	6.629	956.788	979.888
20837.	966.492	6.638	956.288	978.688

No Failures

Figure 3-22. R2045P102 - Phase VI - Capacitance



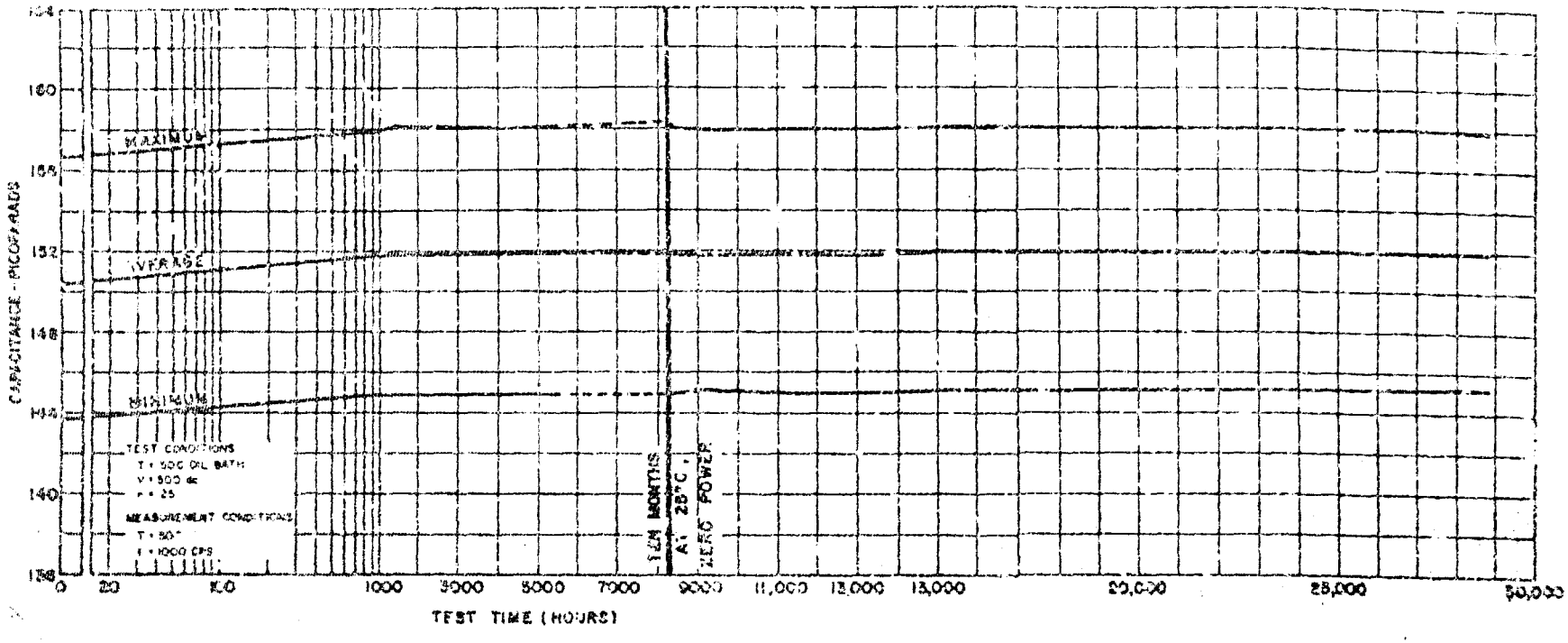
P/N & R2045P122A — CAPACITANCE VALUES IN [illegible]

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	1193.920	14.847	1170.000	1215.000
1058.	1198.880	14.195	1178.000	1219.000
1568.	1195.360	14.457	1180.000	1219.000
4152.	1196.120	14.339	1179.000	1218.000
5532.	1196.240	14.494	1179.000	1218.000
8316.	1197.920	14.434	1179.000	1218.000
6476.	1197.880	14.486	1179.000	1218.000
9394.	1197.960	14.490	1179.000	1218.000
11000.	1197.920	14.906	1179.000	1218.000
13321.	1197.880	14.419	1179.000	1218.000
15481.	1197.880	14.939	1179.000	1218.000
18473.	1197.440	14.664	1179.000	1218.000
20614.	1197.440	14.921	1179.000	1218.000
24513.	1197.640	14.949	1179.000	1218.000
26827.	1196.960	[illegible]	1178.000	1217.000

No Failures

Figure 3-23. R2045P122A - Phase VI - Capacitance

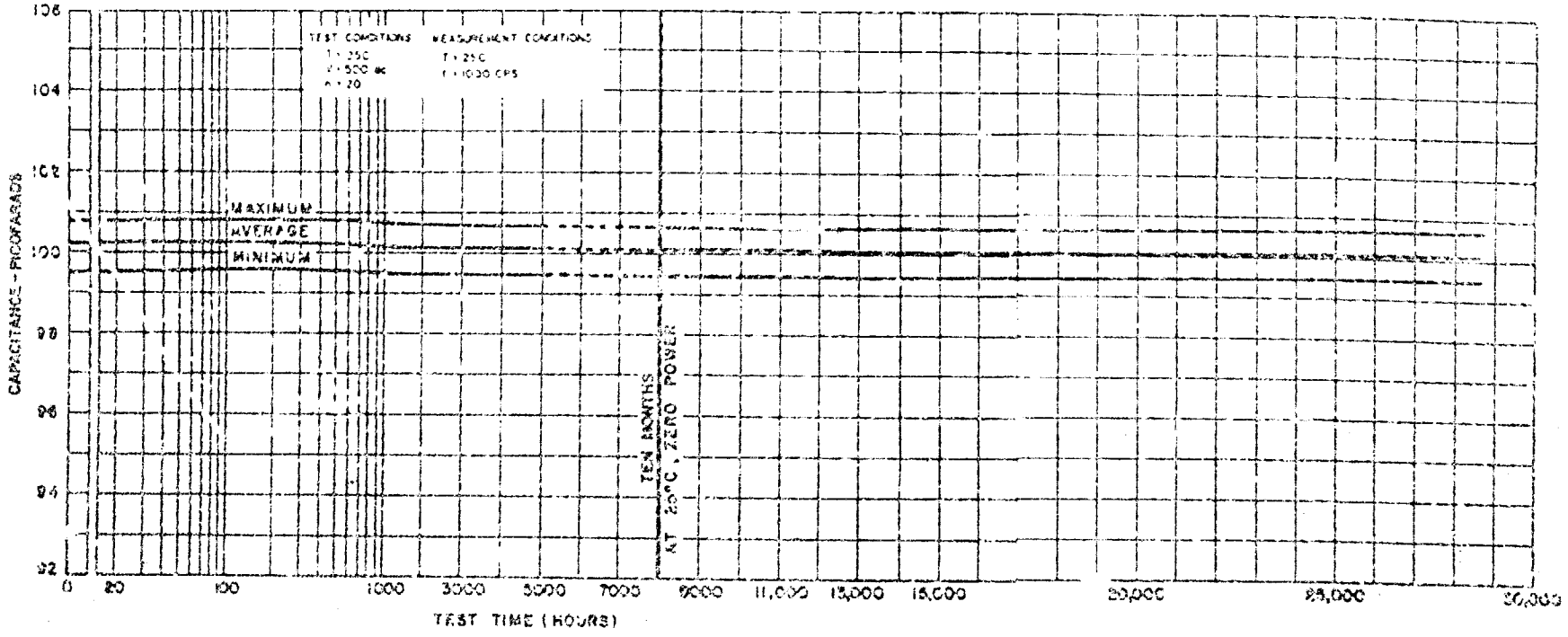


CAPACITANCE VALUE IN MMF

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	151.733	3.484	145.888	157.968
1848.	151.756	3.458	145.908	157.968
1938.	151.594	3.491	144.988	159.188
5138.	151.832	3.441	145.988	158.888
5932.	151.938	3.493	144.988	158.188
6304.	151.836	3.478	144.988	158.208
6476.	151.768	3.435	145.988	157.988
7264.	151.788	3.482	145.188	157.788
11498.	151.716	3.488	144.988	157.868
12254.	151.672	3.417	144.988	157.868
17681.	151.888	3.428	145.868	158.868
18478.	151.736	3.435	144.988	157.968
22414.	151.788	3.437	145.888	157.988
23319.	151.848	3.432	145.888	158.888
23827.	151.812	3.448	144.988	157.868

No Failures

Figure 3-24. R2045P151 - Phase VI - Capacitance



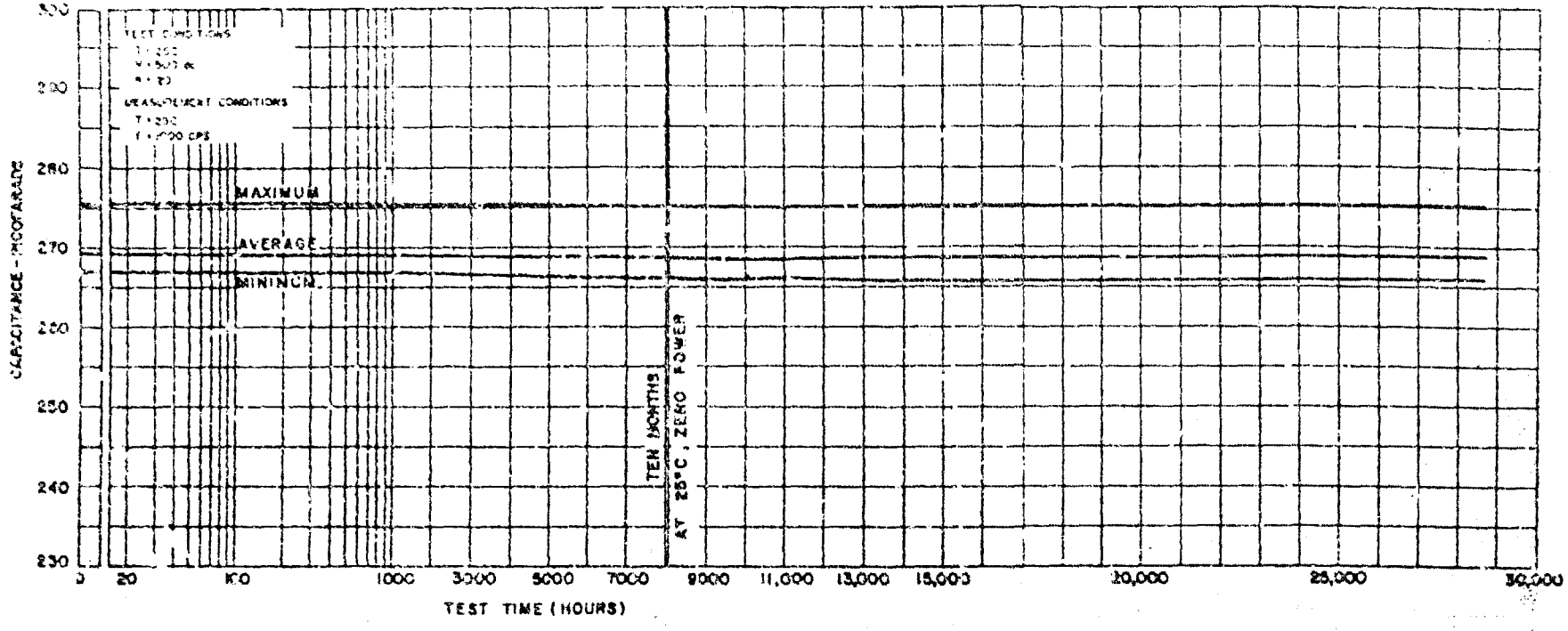
AMBIENT LIFE RESISTORS — CAPACITANCE VALUES IN MMF

20 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	100.538	0.569	99.328	101.965
80.	100.523	0.577	99.066	101.790
170.	100.542	0.577	99.080	101.150
676.	100.332	0.577	98.878	101.579
1356.	100.430	0.579	98.979	101.878
4343.	100.403	0.579	98.965	101.848
9886.	100.428	0.581	98.986	101.896
9858.	100.407	0.575	98.949	101.865
9884	100.414	0.571	98.984	101.834
9562.	100.411	0.572	98.979	101.838
9864.	100.423	0.573	98.990	101.845
11071.	100.429	0.575	98.977	101.878
13213.	100.394	0.572	98.950	101.838
13752.	100.370	0.571	98.940	101.800
15609.	100.392	0.574	98.982	101.802
21871.	100.353	0.578	98.895	101.805
25179.	100.353	0.577	98.898	101.804
29079.	100.337	0.575	98.892	101.833

No Failures

Figure 3-23. RS045P101 - Ambient Life - Capacitance



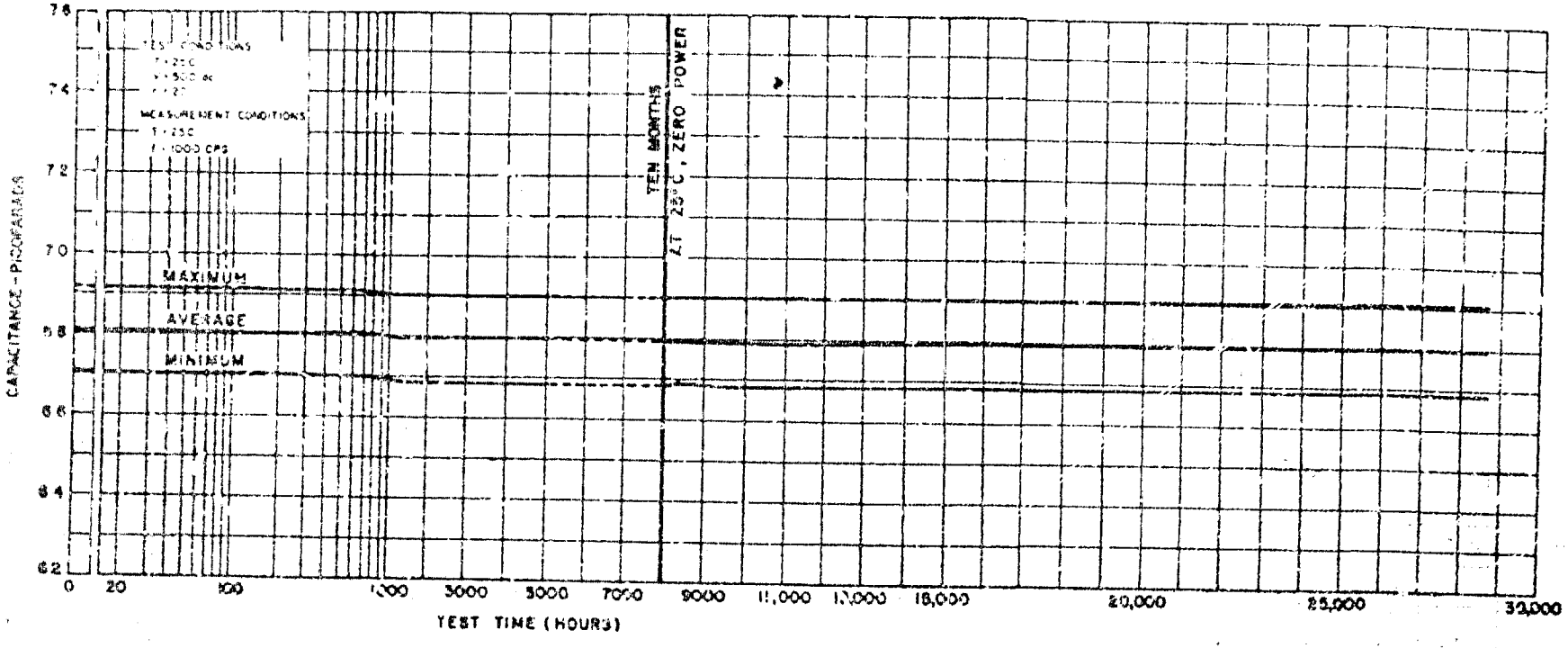
AMBIENT LIFE R2045P271 — CAPACITANCE VALUES IN MMF

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	269.287	2.358	265.906	275.856
59.	269.237	2.438	264.656	275.094
172.	269.202	2.433	264.606	275.088
476.	269.245	2.434	264.938	275.469
1196.	269.118	2.436	264.794	275.499
4732.	269.187	2.434	264.738	275.388
9186.	269.167	2.449	264.794	275.906
6296.	269.162	2.449	264.688	275.456
8724.	269.145	2.428	264.988	275.388
9367.	269.187	2.437	264.688	275.456
10806.	269.062	2.438	264.612	275.356
11261.	269.078	2.448	264.694	275.900
13219.	269.015	2.444	264.656	275.650
15734	269.075	2.436	264.594	275.390
18469.	269.019	2.438	264.694	275.469
21473.	268.962	2.448	264.375	275.444
23178.	268.847	2.445	264.438	275.350
25868.	269.068	2.446	264.938	275.988

No Failures

Figure 3-26. R2045P271 - Ambient Life - Capacitance



AMBIENT LIFE R2045P680

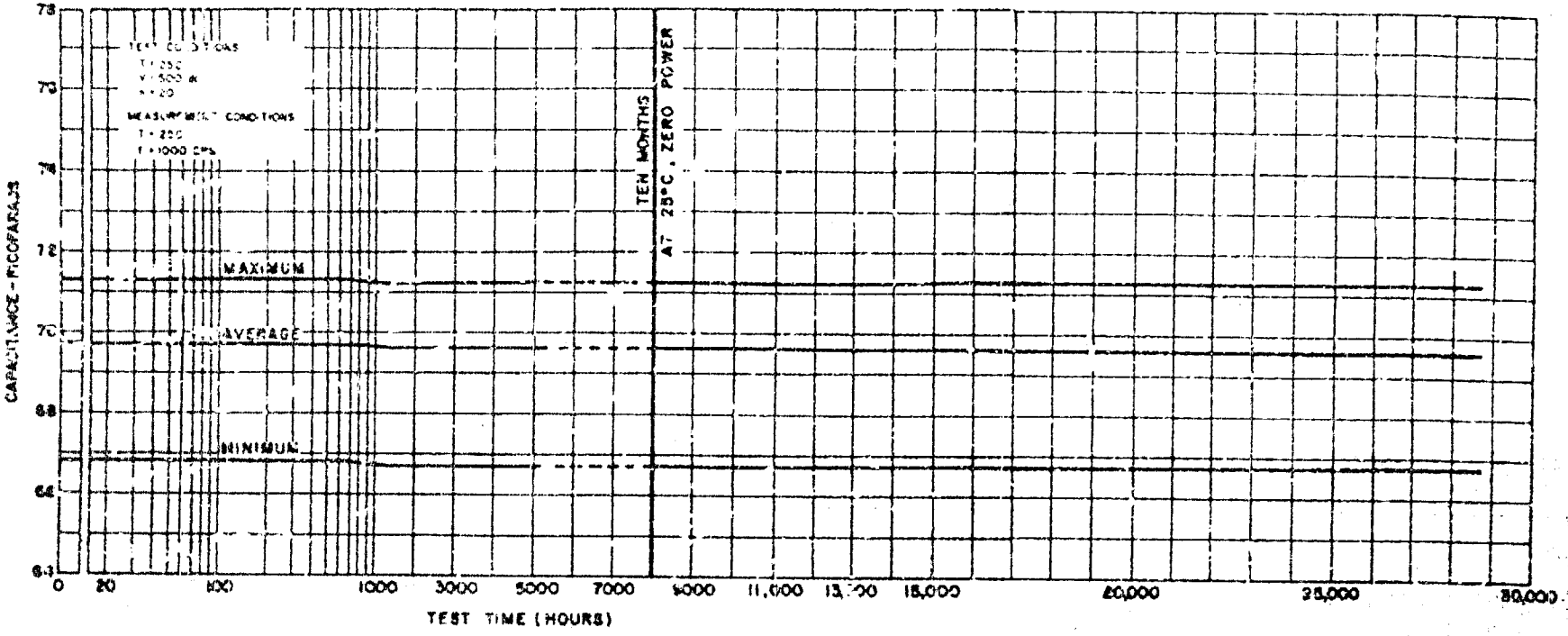
CAPACITANCE VALUES IN MMF

20 PART.

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	68.367	0.642	67.3[illegible]	69.473
20.	68.370	0.669	67.300	69.465
172.	68.354	0.648	67.318	69.478
476.	68.304	0.646	67.269	69.425
1392.	68.269	0.648	67.195	69.358
4043.	68.239	0.644	67.193	69.338
5286.	68.196	0.645	67.175	69.358
6256.	68.162	0.648	67.180	69.353
8224.	68.173	0.646	67.178	69.369
8536.	68.275	0.648	67.284	69.379
9480.	68.298	0.647	67.178	69.349
11841.	68.288	0.650	67.196	69.383
13219.	68.276	0.649	67.168	69.328
15734.	68.271	0.648	67.178	69.369
17479.	68.264	0.647	67.319	69.493
21673.	68.248	0.648	67.119	69.358
25177.	68.277	0.647	67.318	69.488
28488.	68.289	0.649	67.319	69.485

No Failures

Figure 3-27. R2045P680 - Ambient Life - Capacitance

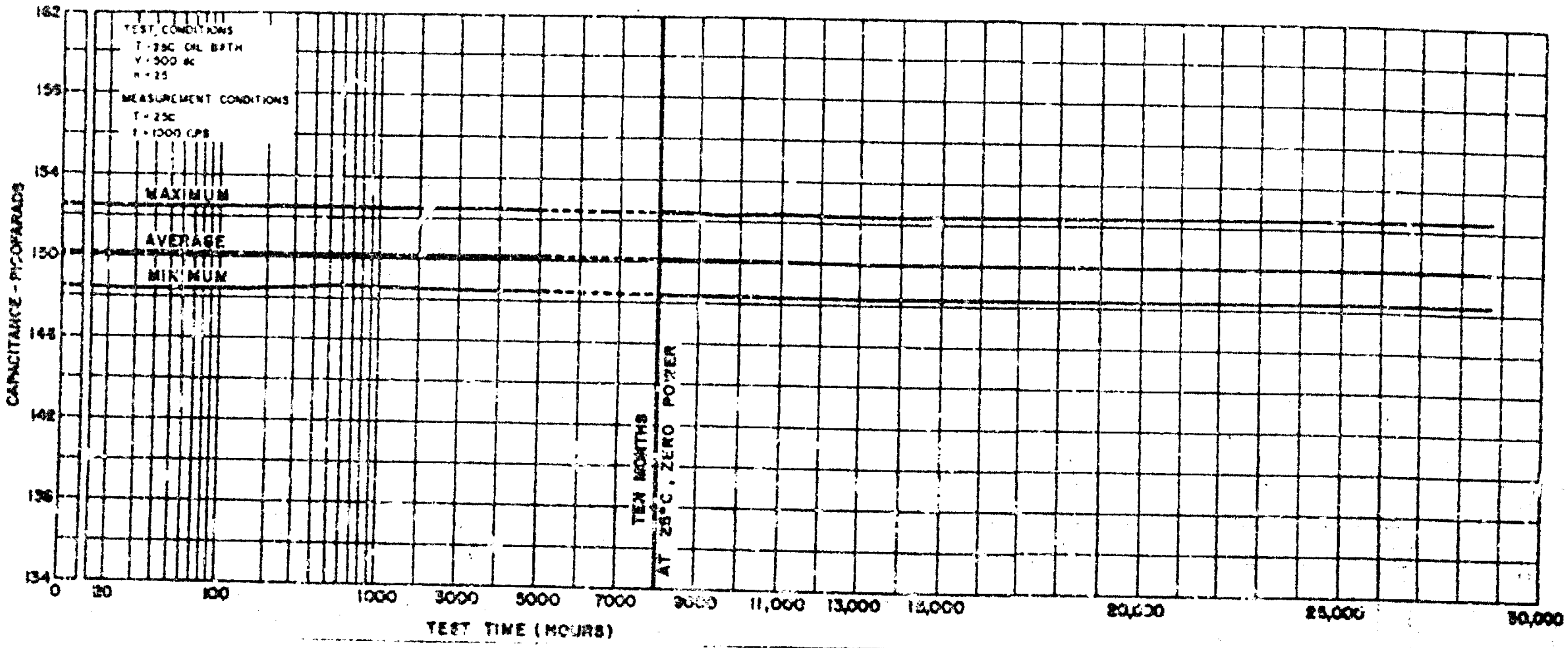


AMBIENT LIFE RESISTANCE — CAPACITANCE VALUES IN MMF

TEST HOURS	28 PARTS AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	70.614	1.498	67.119	73.421
20.	70.614	1.496	67.139	73.409
172.	70.638	1.497	67.145	73.446
[illegible]	70.616	1.498	[illegible]	73.889
1356.	69.912	1.497	67.930	73.919
4843.	69.891	1.496	67.089	73.911
5266.	69.906	1.496	67.010	73.944
6716.	69.917	1.499	67.038	73.930
8334.	[illegible]	1.497	67.019	73.919
9547.	69.929	[illegible]	[illegible]	73.936
9884.	69.918	1.496	67.036	73.956
11541.	69.929	1.498	67.038	73.968
13216.	69.896	1.499	67.018	73.906
13734.	69.912	1.496	67.023	[illegible]
19690.	70.843	1.493	[illegible]	73.445
21872.	69.813	1.476	[illegible]	73.450
25176.	70.829	1.498	67.148	73.889
28588.	70.842	1.498	67.198	73.892

No Failures

Figure 3-28. R2045P680 Rev. A Ambient Life - Capacitance



AMBIENT LIFE R2045P151

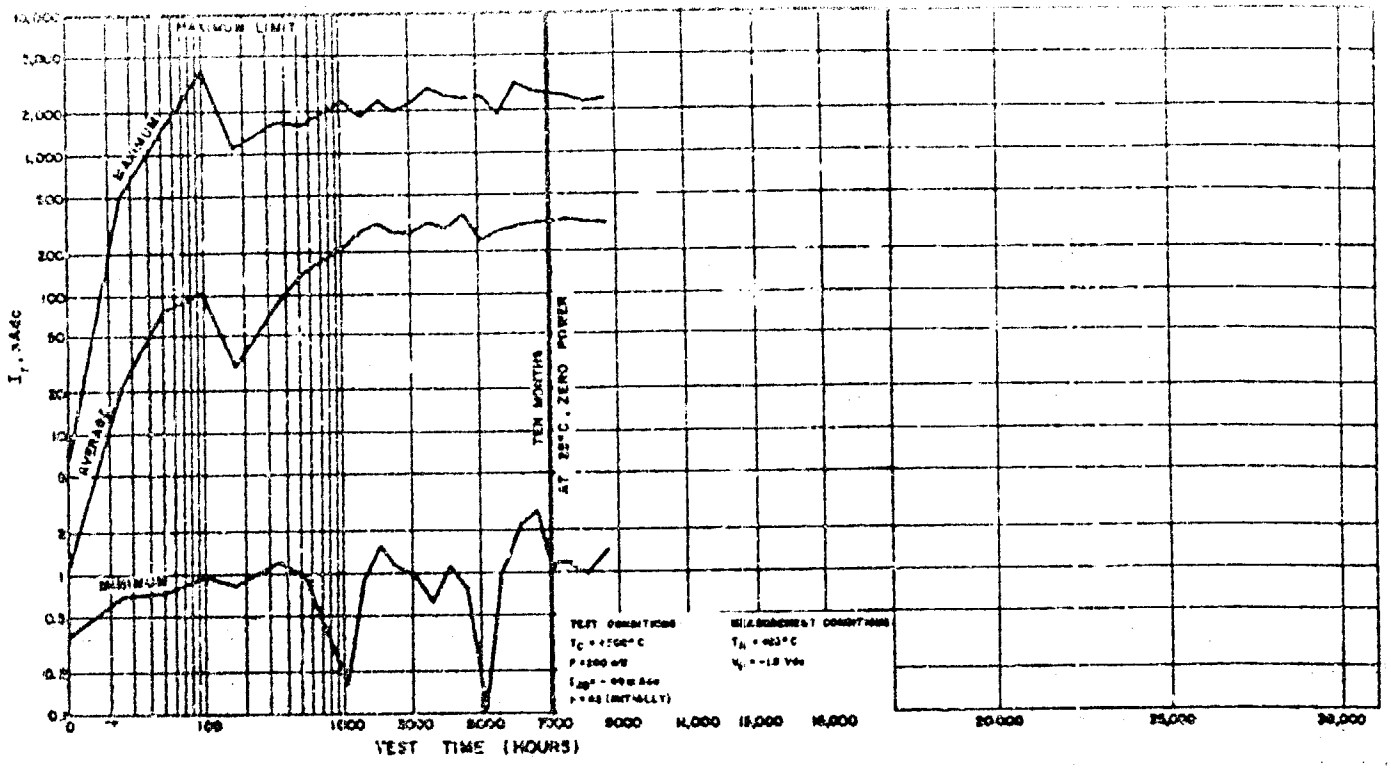
CAPACITANCE VALUES IN MMF

25 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	150.452	1.255	148.730	152.790
29.	150.412	1.230	149.[illegible]	152.800
172.	150.457	1.236	148.7[illegible]	152.760
476.	150.455	1.218	148.[illegible]	152.710
1376.	150.355	1.216	148.790	152.040
4243.	150.337	1.219	148.[illegible]	152.000
7256.	150.335	1.223	148.630	152.000
8258.	150.323	1.224	148.[illegible]	152.000
8224.	150.310	1.224	148.600	152.000
[illegible]	150.145	1.224	148.[illegible]	152.[illegible]
9667.	150.[illegible]	1.212	148.[illegible]	151.900
11061.	150.332	1.222	148.[illegible]	151.[illegible]
12215.	150.297	1.238	148.670	151.[illegible]
15734.	150.207	1.247	148.[illegible]	151.9[illegible]
18660.	150.400	1.255	148.770	152.[illegible]
21873.	150.27	1.207	148.[illegible]	152.[illegible]
25179.	150.412	1.202	148.[illegible]	152.700
28666.	150.420	1.183	148.750	152.702

No Failures

Figure 3-29. R2045P151 - Ambient Life - Capacitance



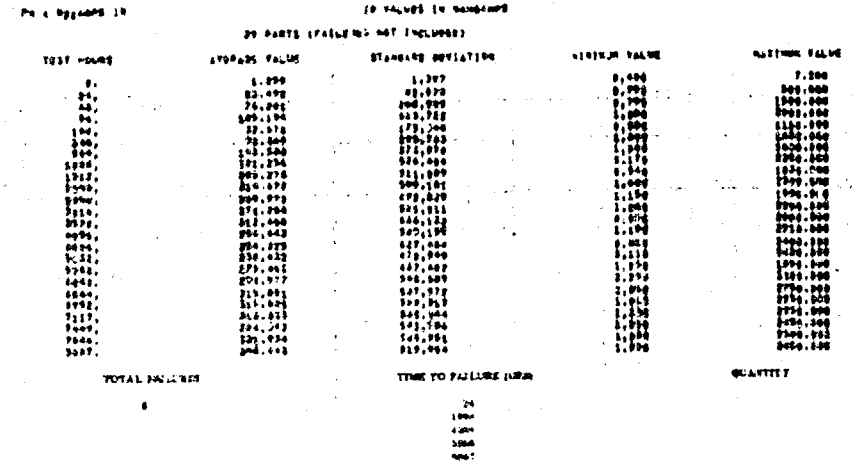
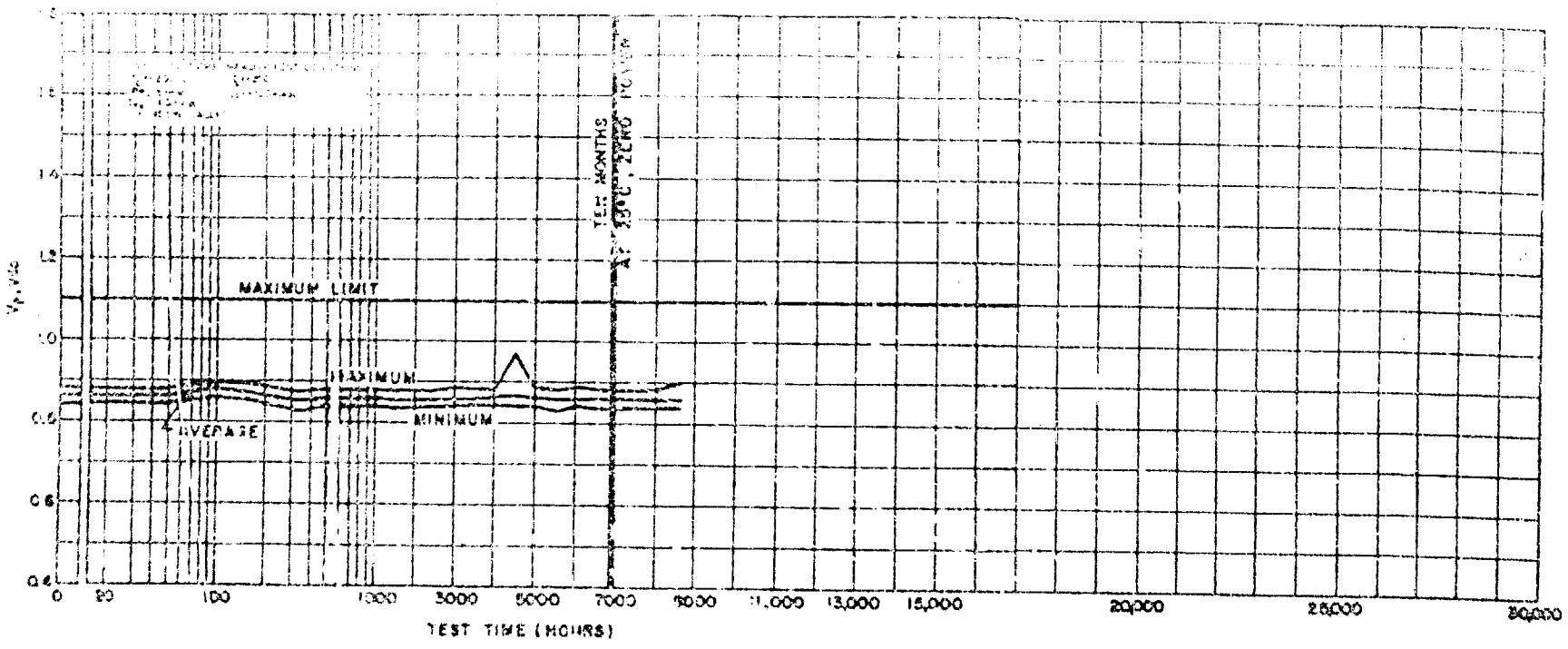


Figure 3-30. R2008P5, Phase IV, I_R

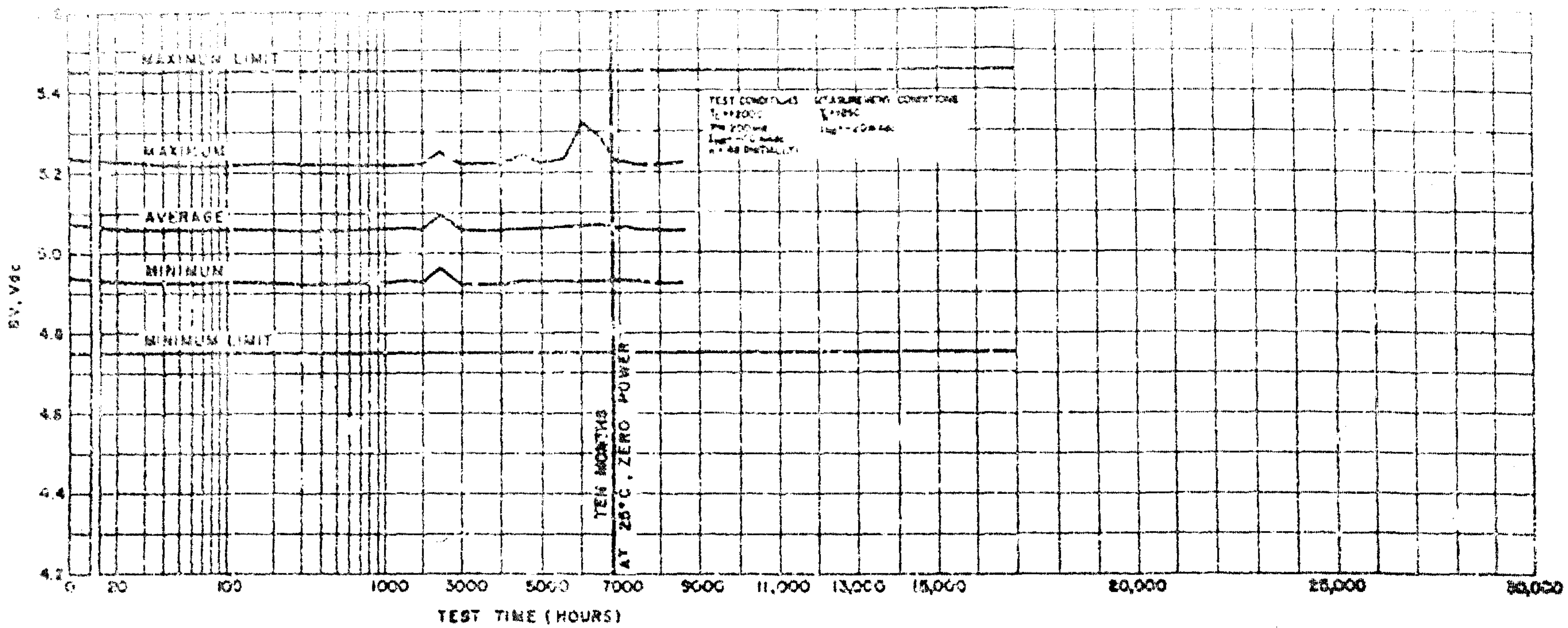


TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	0.842	0.009	0.844	0.881
20	0.841	0.009	0.843	0.879
48	0.842	0.010	0.843	0.881
96	0.842	0.010	0.844	0.880
168	0.874	0.009	0.891	0.898
340	0.857	0.009	0.859	0.878
504	0.856	0.008	0.842	0.870
1008	0.862	0.009	0.845	0.882
1512	0.858	0.009	0.836	0.879
2184	0.855	0.009	0.837	0.878
3528	0.858	0.009	0.840	0.879
4816	0.862	0.010	0.837	0.897
5784	0.864	0.009	0.849	0.884
7095	0.862	0.010	0.843	0.883
8328	0.864	0.010	0.847	0.878
9240	0.864	0.011	0.846	0.889
9408	0.858	0.010	0.831	0.882
9576	0.861	0.011	0.840	0.889
9744	0.860	0.010	0.838	0.883
9912	0.860	0.010	0.842	0.881
10080	0.860	0.010	0.842	0.882
10248	0.863	0.010	0.843	0.882
10416	0.859	0.010	0.841	0.882
10584	0.860	0.011	0.838	0.884
10752	0.862	0.013	0.843	0.884

TOTAL FAILURES
0

TIME TO FAILURE (HRS)	QUANTITY
24	1
1968	1
4584	1
5760	1
6672	1

Figure 3-31. R2008P5, Phase IV, V_F



PH 4 R200SP5 BV

BV VALUES IN VOLTS

39 PARTS (FAILURES NOT INCLUDED)

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
5.	5.073	0.032	4.949	5.214
23.	5.076	0.053	4.996	5.219
44.	[illegible]	0.064	4.922	5.215
95.	5.059	0.033	4.929	5.219
150.	5.057	0.055	4.929	5.228
500.	5.058	0.059	4.933	5.219
550.	5.057	0.037	4.936	5.218
1077.	5.078	0.043	4.935	5.218
1515.	5.058	0.057	4.939	5.218
2158.	5.084	0.053	4.933	5.218
2480.	5.078	0.051	4.997	5.222
3151.	5.133	0.053	4.922	5.319
3500.	5.095	0.053	4.921	5.219
4078.	5.092	0.055	4.919	5.231
4816.	5.058	0.053	4.939	5.239
5532.	5.077	0.062	4.929	5.232
5933.	5.061	0.083	4.929	5.249
6048.	5.065	0.051	4.929	5.319
6514.	5.059	0.040	4.926	5.270
6670.	5.057	0.053	4.929	5.222
7410.	5.062	0.055	4.920	5.222
7440.	5.095	0.057	4.924	5.259
7833.	5.056	0.053	4.921	5.215
8437.	5.095	0.053	4.922	5.229

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
6	24	1
	1008	1
	4788	1
	5568	1
	6007	2

Figure 3-32. R200SP5, Phase IV, BV

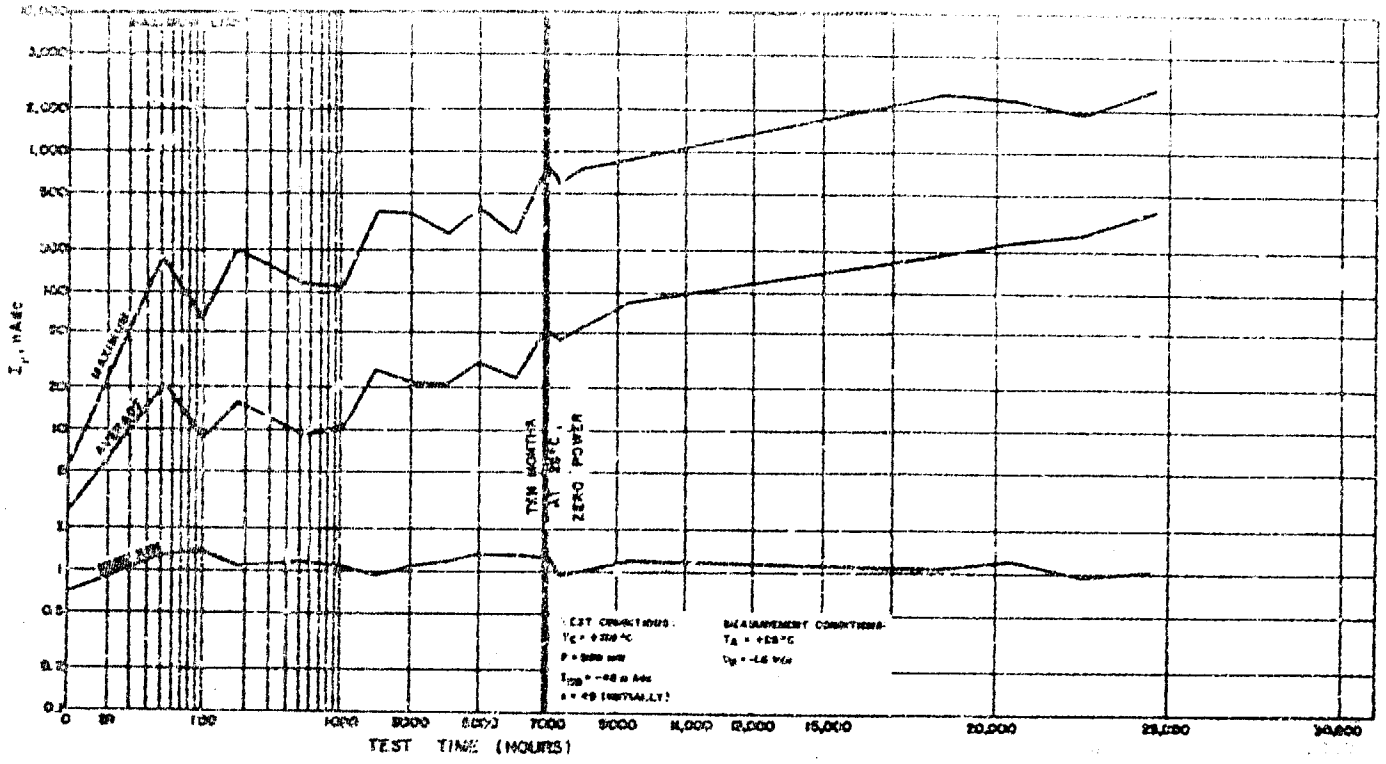
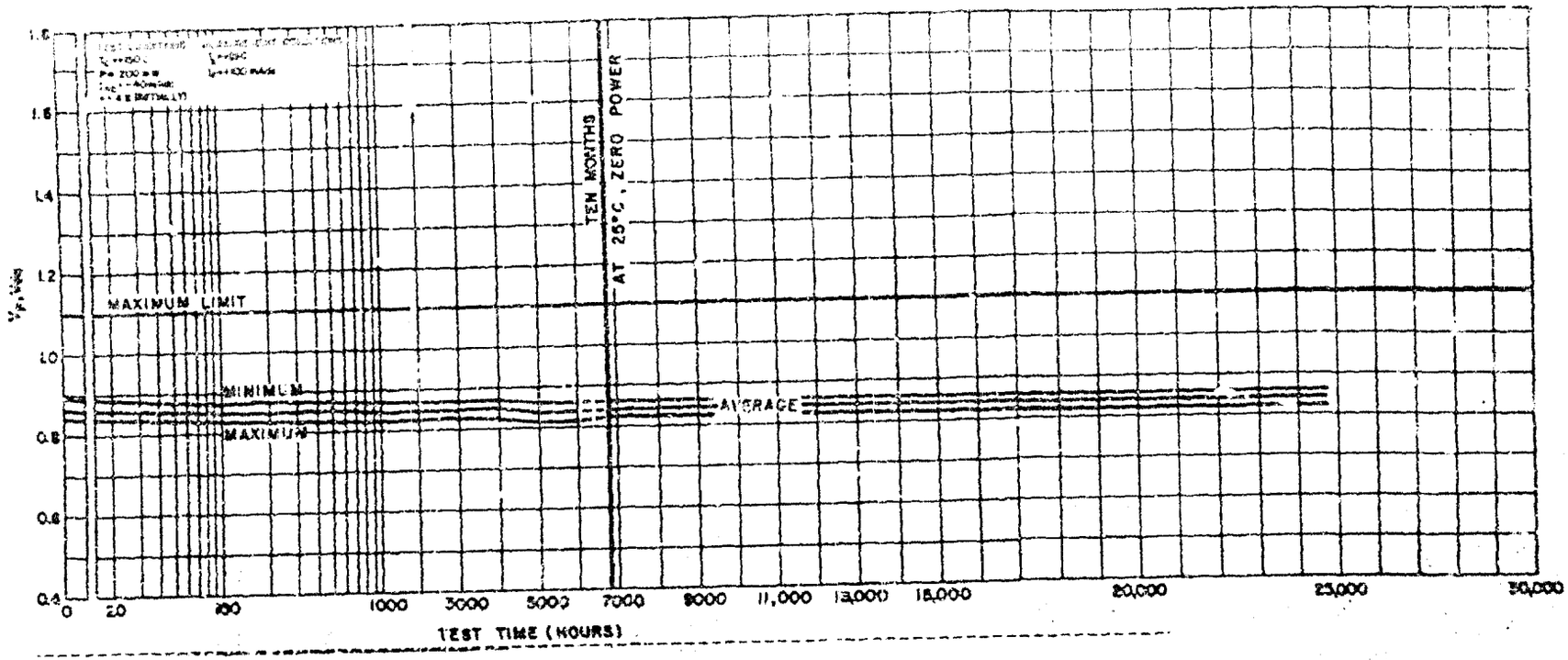


Figure 3-33. R2008P5, Phase V, I_R



Phase 5 R2008P5 VF

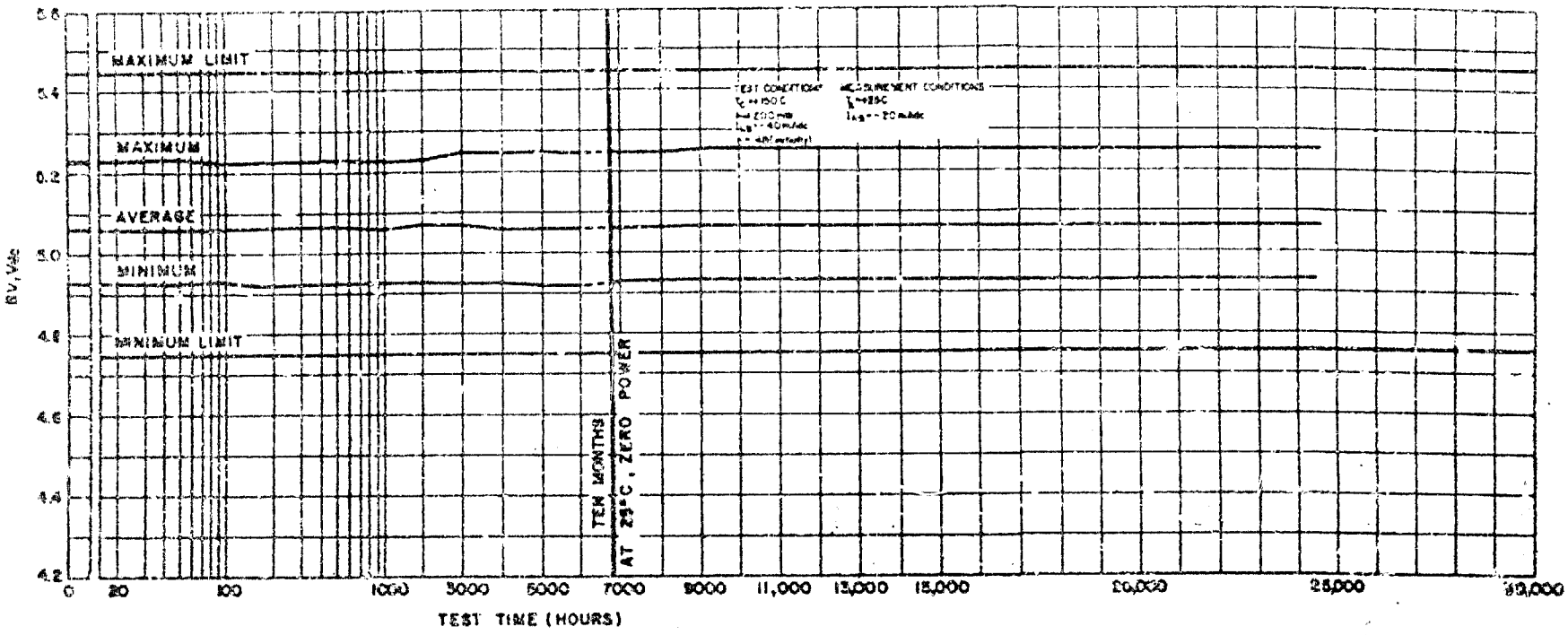
V_F VALUES IN VOLTS

34 PARTS (FAILURES NOT EXCLUDED)

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.644	0.010	0.629	0.665
48.	0.647	0.009	0.639	0.672
93.	0.650	0.010	0.638	0.669
168.	0.651	0.009	0.639	0.674
504.	0.650	0.009	0.641	0.666
1010.	0.645	0.010	0.627	0.666
2688.	0.649	0.010	0.631	0.666
3696.	0.649	0.010	0.641	0.666
4536.	0.652	0.010	0.640	0.668
4993.	0.650	0.010	0.638	0.659
6888.	0.650	0.011	0.628	0.659
6856.	0.644	0.010	0.628	0.662
7216.	0.648	0.010	0.629	0.656
7248.	0.651	0.010	0.634	0.659
7562.	0.651	0.009	0.633	0.659
8272.	0.647	0.010	0.625	0.659
10080.	0.641	0.010	0.624	0.656
12096.	0.639	0.010	0.622	0.656
13968.	0.646	0.010	0.622	0.659
14784.	0.650	0.010	0.621	0.659
14871.	0.650	0.010	0.619	0.659
19344.	0.647	0.010	0.619	0.656
21168.	0.650	0.010	0.619	0.656
22657.	0.650	0.010	0.619	0.656
24697.	0.650	0.010	0.621	0.659

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
0	1010	1
	12096	1

Figure 3-34. R2008P5, Phase V, V_F



PHASE 5 R2008P5 BV

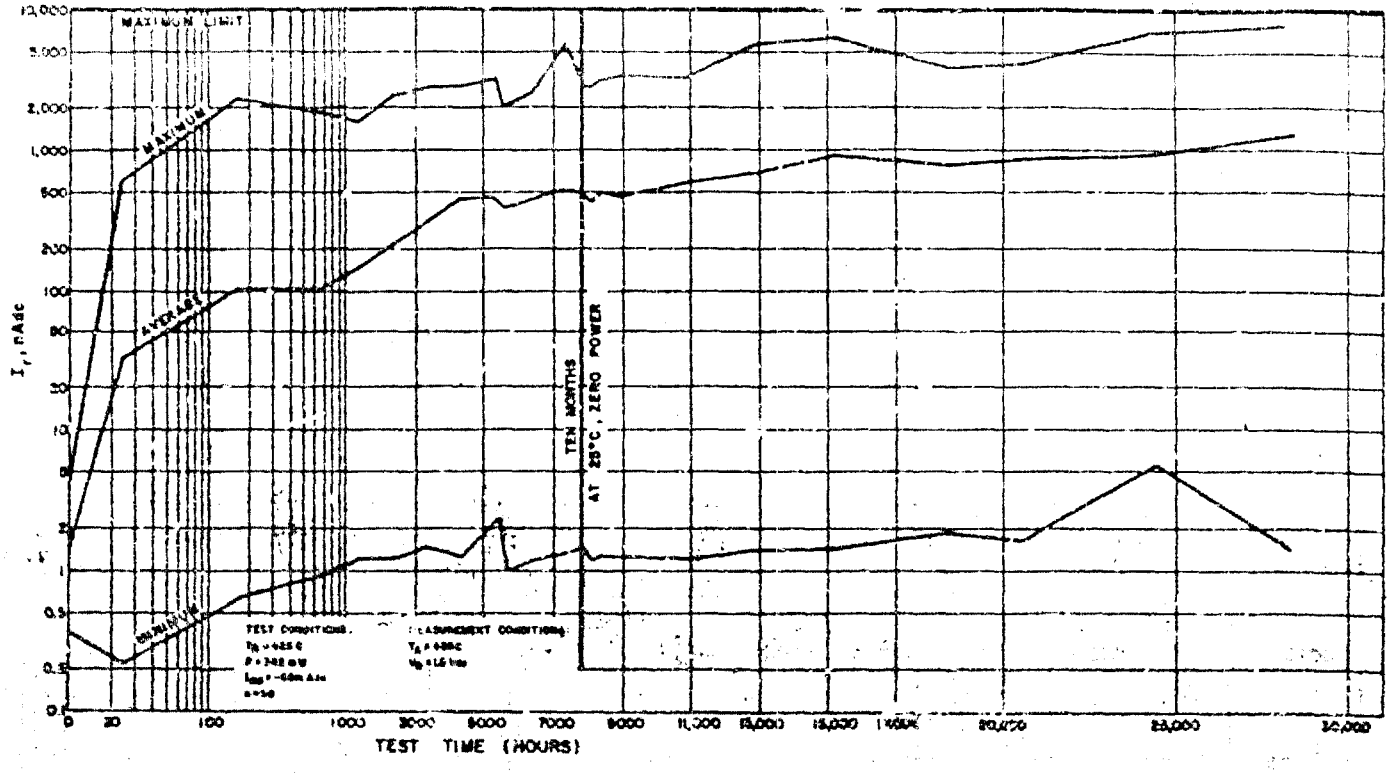
BV VALUES IN VOLTS

34 PARTS (FAILURES NOT INCLUDED)

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	5.054	0.079	4.932	5.230
48.	5.058	0.084	4.928	5.239
93.	5.055	0.086	4.933	5.229
169.	5.054	0.079	4.943	5.236
504.	5.047	0.088	4.925	5.233
1016.	5.046	0.088	4.940	5.241
2481.	5.050	0.079	4.941	5.215
3088.	5.051	0.079	4.948	5.205
4834.	5.057	0.086	4.929	5.239
6991.	5.059	0.091	4.949	5.249
8048.	5.057	0.088	4.938	5.238
8894.	5.047	0.085	4.940	5.234
7016.	5.043	0.086	4.925	5.249
7240.	5.042	0.086	4.923	5.249
7647.	5.045	0.086	4.932	5.240
9320.	5.044	0.087	4.917	5.234
10061.	5.034	0.092	4.888	5.216
12958.	5.034	0.085	4.948	5.234
14844.	5.042	0.083	4.946	5.232
15471.	5.040	0.085	4.934	5.232
15336.	5.038	0.085	4.939	5.234
20830.	5.049	0.086	4.935	5.251
23167.	5.038	0.096	4.851	5.232
24891.	5.033	0.087	4.939	5.236

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
2	1814	1
	13540	1

Figure 3-33. R2008P5, Phase V, BV



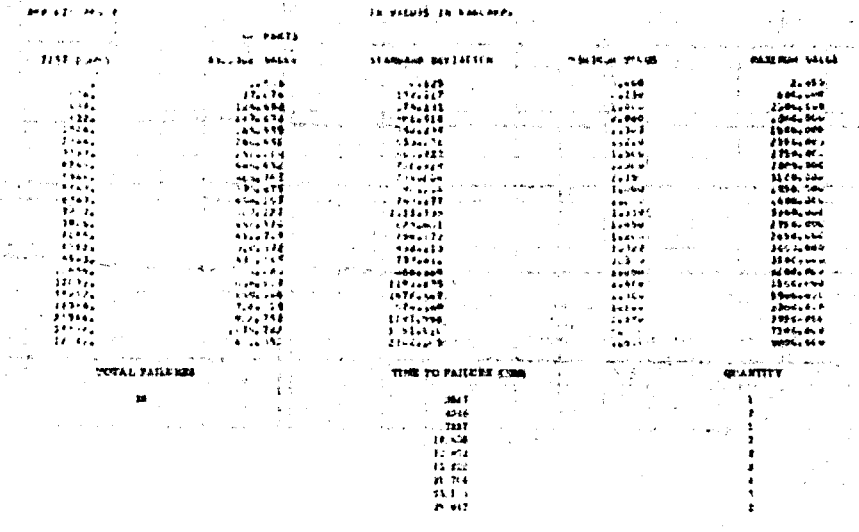
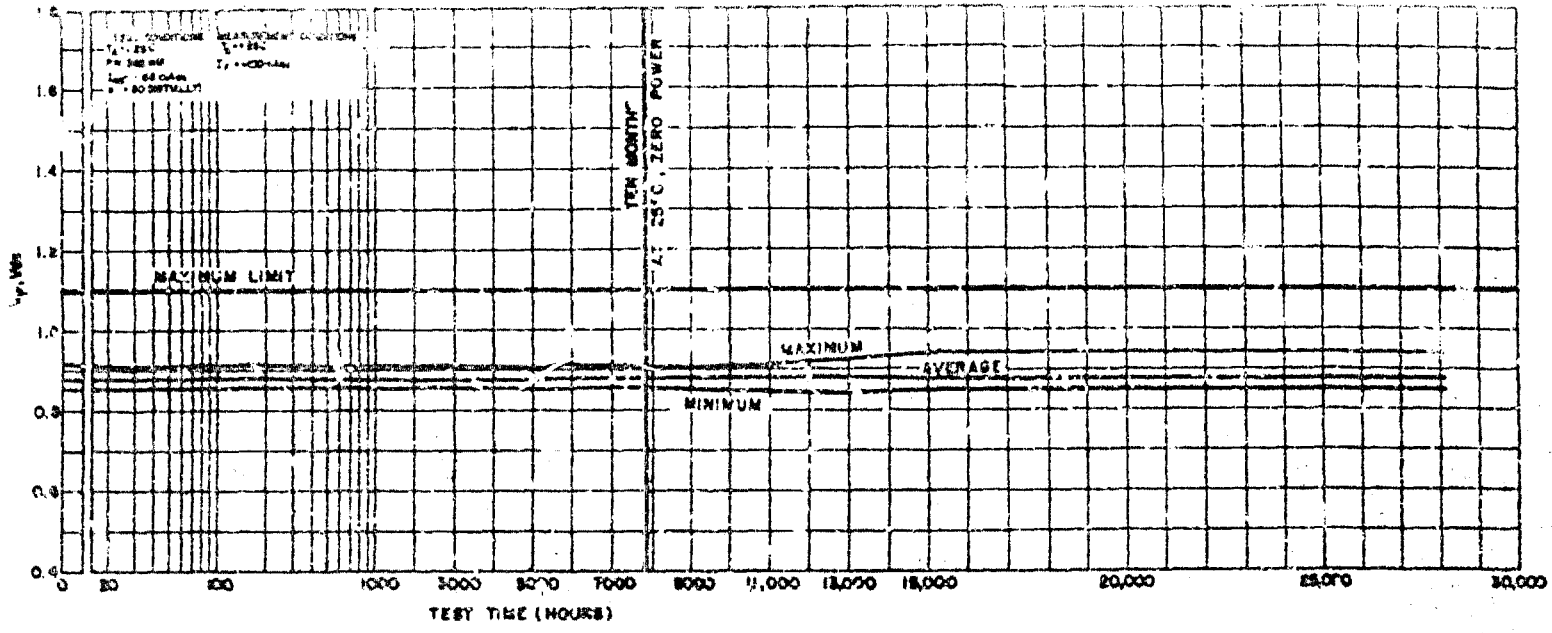
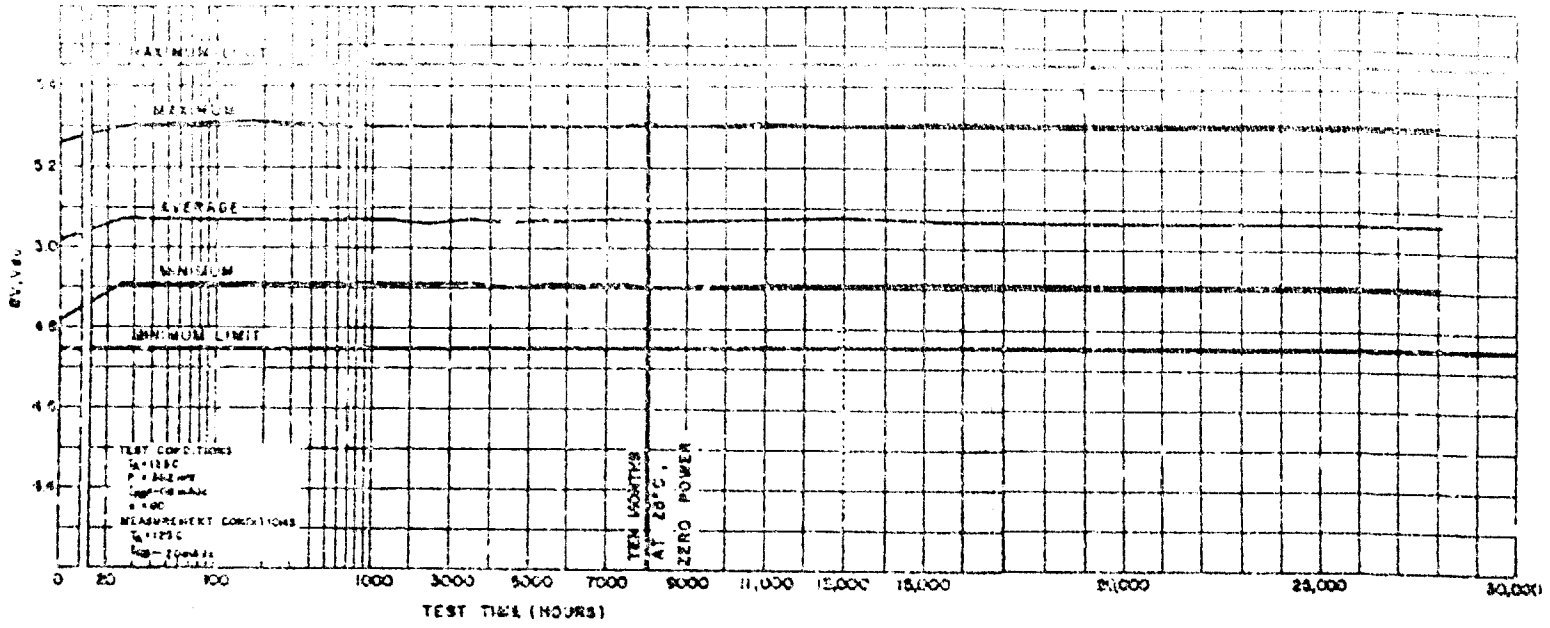


Figure 3-36. R2008P5, Ambient Life L_R



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
36	[illegible]	[illegible]



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	5.132	.111	4.823	5.259
20	5.141	.113	4.913	5.291
100	5.138	.111	4.914	5.291
1000	5.139	.111	4.921	5.290
3000	5.139	.111	4.909	5.289
5000	5.135	.111	4.905	5.284
7000	5.135	.111	4.868	5.278
9000	5.134	.111	4.882	5.284
11000	5.138	.111	4.894	5.291
15000	5.137	.111	4.904	5.289
25000	5.138	.111	4.914	5.289
30000	5.138	.111	4.917	5.290
30000	5.138	.112	4.904	5.287
30000	5.138	.111	4.905	5.287
30000	5.133	.111	4.903	5.286
30000	5.138	.111	4.908	5.290
30000	5.137	.112	4.912	5.293
30000	5.137	.112	4.910	5.293
30000	5.137	.112	4.912	5.293
30000	5.137	.112	4.911	5.290
30000	5.137	.112	4.911	5.287
30000	5.137	.112	4.914	5.288
30000	5.137	.112	4.913	5.284

TOTAL FAILURES
30

TIME TO FAILURE (HRS)	QUANTITY
7047	1
9344	1
7327	1
10,870	1
11,372	2
14,330	1
21,794	4
26,178	1
28,542	2

Figure 3-38. R2008P5, Ambient Life, BV

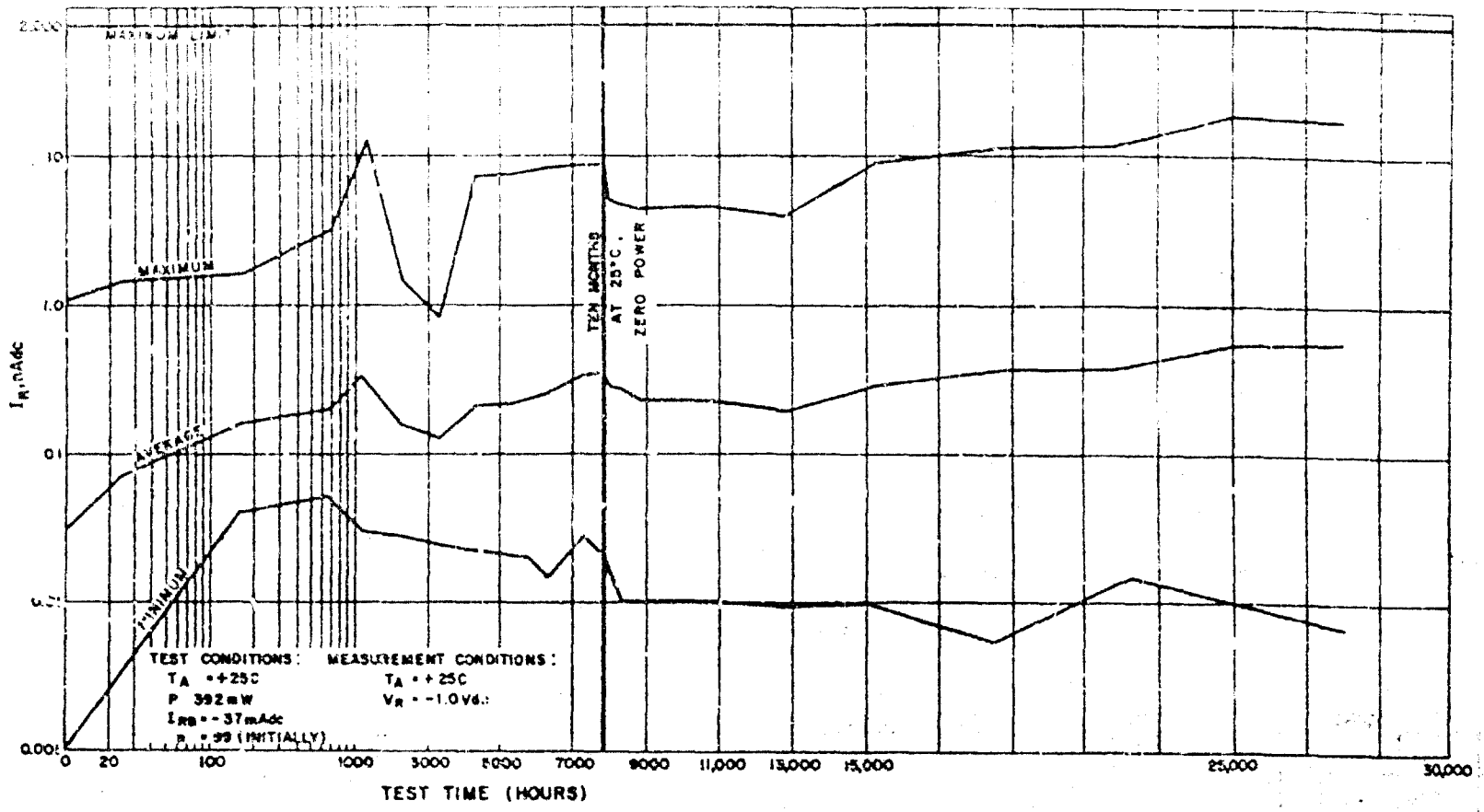
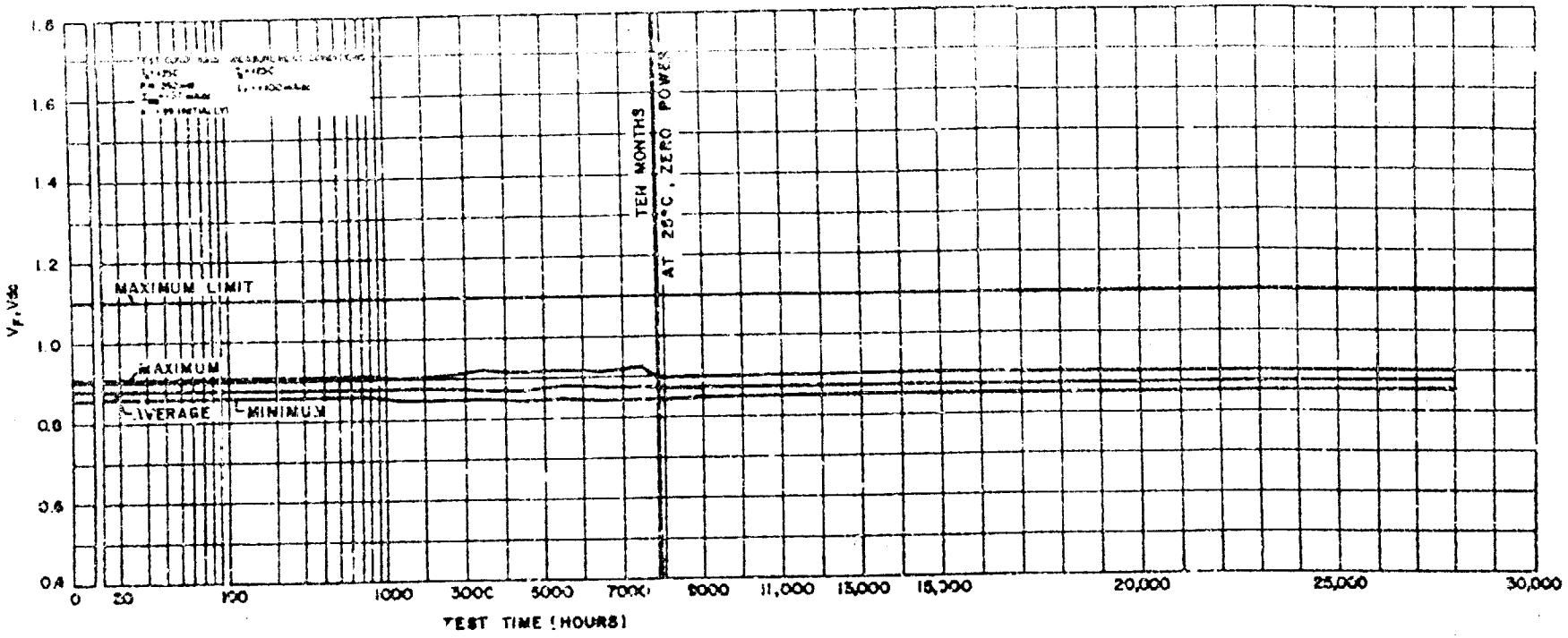


Figure 3-39. Parameter Trend Chart, R2008P10, Ambient Life, I_R



AMBLIFE R2008P10 VF

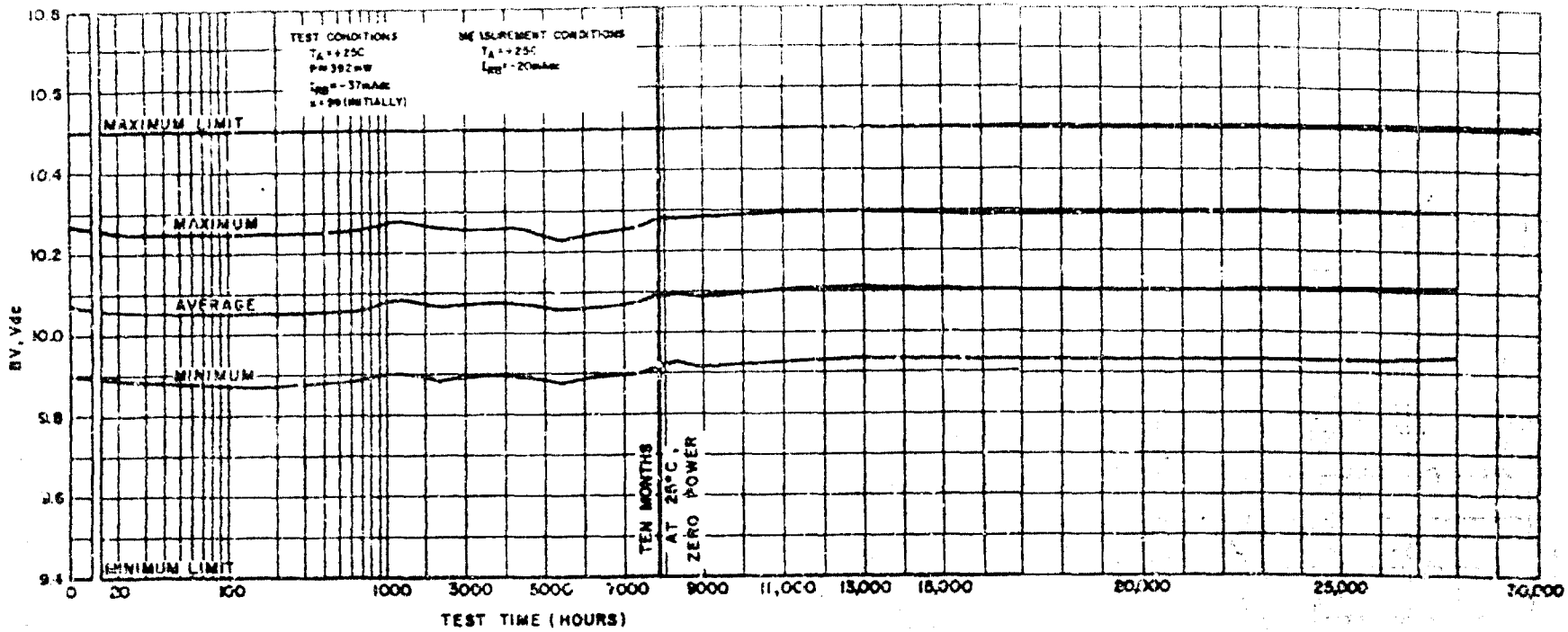
VF VALUES IN VOLTS

60 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.886	0.011	0.863	0.913
24.	0.885	0.011	0.863	0.912
168.	0.889	0.012	0.862	0.912
672.	0.884	0.012	0.868	0.910
1336.	0.879	0.012	0.859	0.908
2344.	0.881	0.013	0.859	0.903
3344.	0.878	0.013	0.853	0.910
4344.	0.877	0.012	0.849	0.915
5344.	0.888	0.013	0.851	0.920
6344.	0.879	0.014	0.849	0.919
7344.	0.878	0.014	0.849	0.920
7548.	0.876	0.012	0.858	0.904
8614.	0.876	0.012	0.858	0.904
8341.	0.874	0.012	0.851	0.903
8932.	0.874	0.012	0.851	0.904
10014.	0.875	0.012	0.851	0.904
12631.	0.874	0.013	0.852	0.909
15101.	0.873	0.012	0.848	0.902
18718.	0.874	0.013	0.849	0.903
21743.	0.874	0.012	0.852	0.902
23899.	0.874	0.012	0.850	0.905
25861.	0.878	0.013	0.852	0.906

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
1	15,131	1

Figure 3-40. Parameter Trend Chart, R2008P10, Ambient Life, V_F



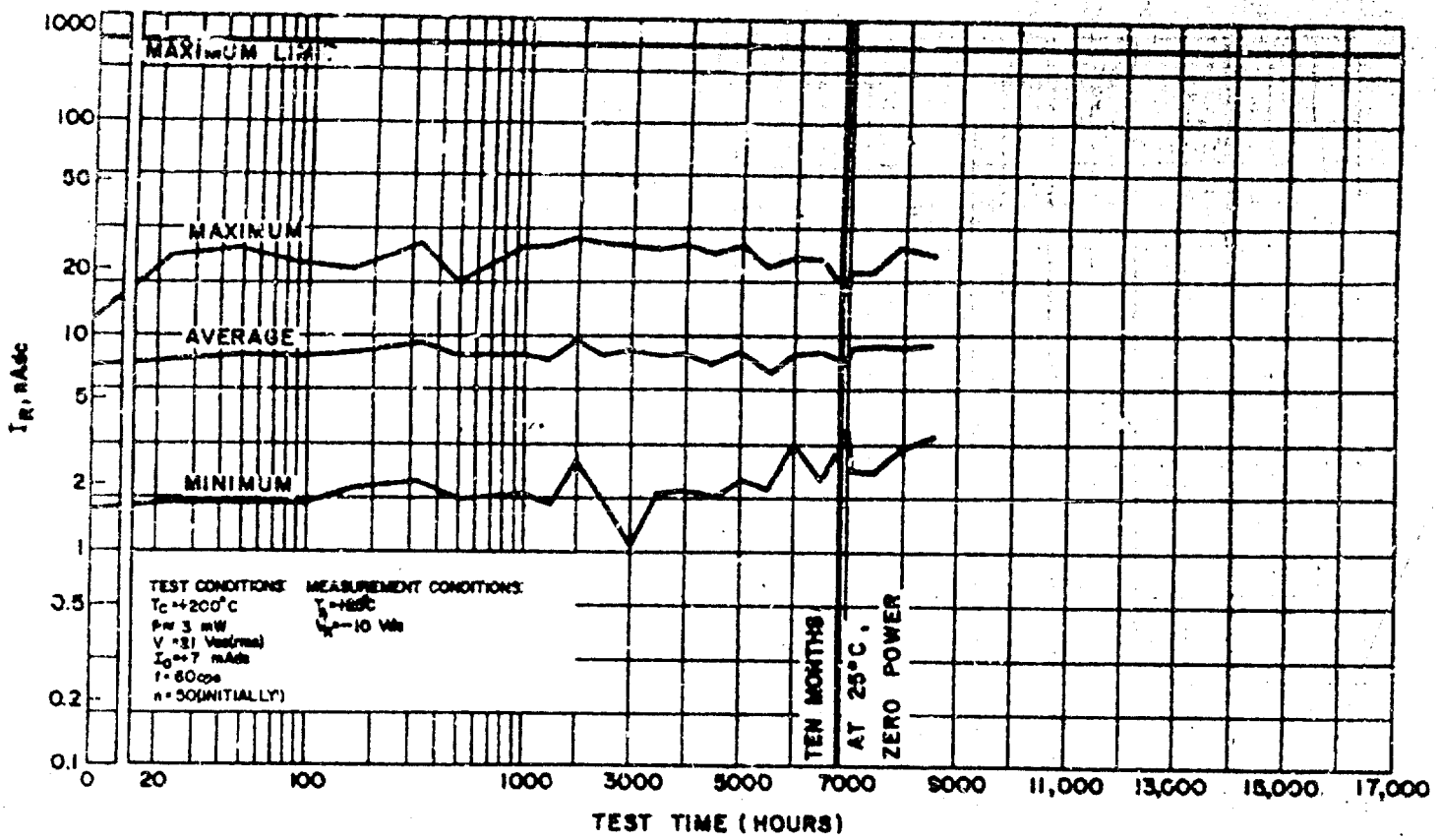
BV VALUES IN VOLTS

89 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	10.073	0.086	9.924	10.269
24.	10.056	0.091	9.889	10.249
144.	10.056	0.092	9.879	10.249
672.	10.062	0.093	9.889	10.259
1344.	10.086	0.093	9.919	10.279
2344.	10.065	0.091	9.888	10.259
3344.	10.071	0.090	9.899	10.259
4344.	10.073	0.091	9.899	10.259
5344.	10.071	0.091	9.879	10.229
6344.	10.069	0.090	9.899	10.249
7344.	10.067	0.089	9.899	10.259
7848.	10.076	0.091	9.922	10.284
8614.	10.089	0.091	9.921	10.282
8341.	10.094	0.091	9.939	10.284
8822.	10.087	0.091	9.916	10.286
10814.	10.102	0.091	9.931	10.294
12631.	10.109	0.090	9.937	10.297
15102.	10.106	0.091	9.937	10.292
18713.	10.105	0.090	9.928	10.284
21743.	10.101	0.091	9.925	10.282
25095.	10.108	0.090	9.926	10.288
28031.	10.093	0.090	9.919	10.268

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
1	15,141	1

Figure 3-41. Parameter Trend Chart, R2008P10, Ambient Life, BV



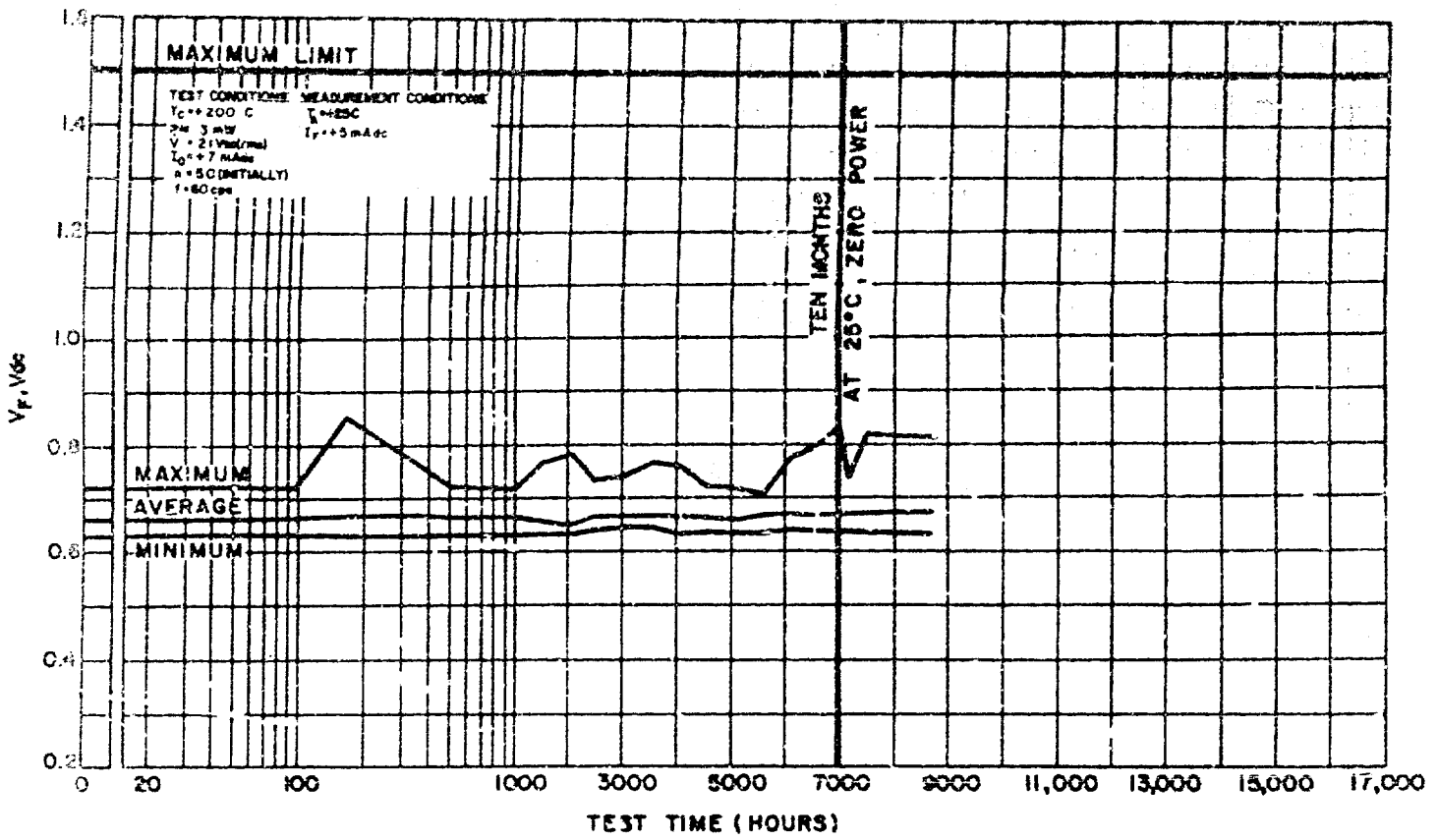
PH 4 R2010P1 1A — IR VALUES IN NANOAMPS

49 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	7.152	2.923	1.650	11.500
24.	7.944	3.087	1.720	24.500
48.	8.132	3.127	1.730	25.000
96.	8.165	3.022	1.700	24.000
168.	8.670	2.933	1.950	20.000
340.	9.353	3.457	2.150	26.800
504.	8.084	3.224	1.800	24.500
1000.	8.567	3.469	1.950	26.500
1512.	7.768	3.308	1.700	25.100
2000.	8.099	3.769	2.070	28.000
2496.	8.094	3.502	1.800	26.500
3000.	8.417	3.583	1.930	25.500
3520.	7.908	3.322	1.900	25.000
4000.	8.010	3.585	1.990	26.800
4520.	7.824	3.297	1.850	24.500
5032.	8.241	3.516	2.250	26.000
5536.	8.798	4.978	1.900	21.500
6040.	8.618	3.151	3.100	23.000
6544.	8.638	3.407	2.200	23.000
6992.	7.742	4.749	3.600	18.000
7119.	8.049	3.197	2.400	19.500
7449.	8.410	3.532	2.400	19.800
7992.	8.653	3.804	3.000	20.500
8603.	9.280	4.121	3.500	23.500

TOTAL FAILURES: 1 — TIME TO FAILURE (HRS): 4884 — QUANTITY: 1

Figure 3-42. Parameter Trend Chart, R2010P1 Phase IV, I_R



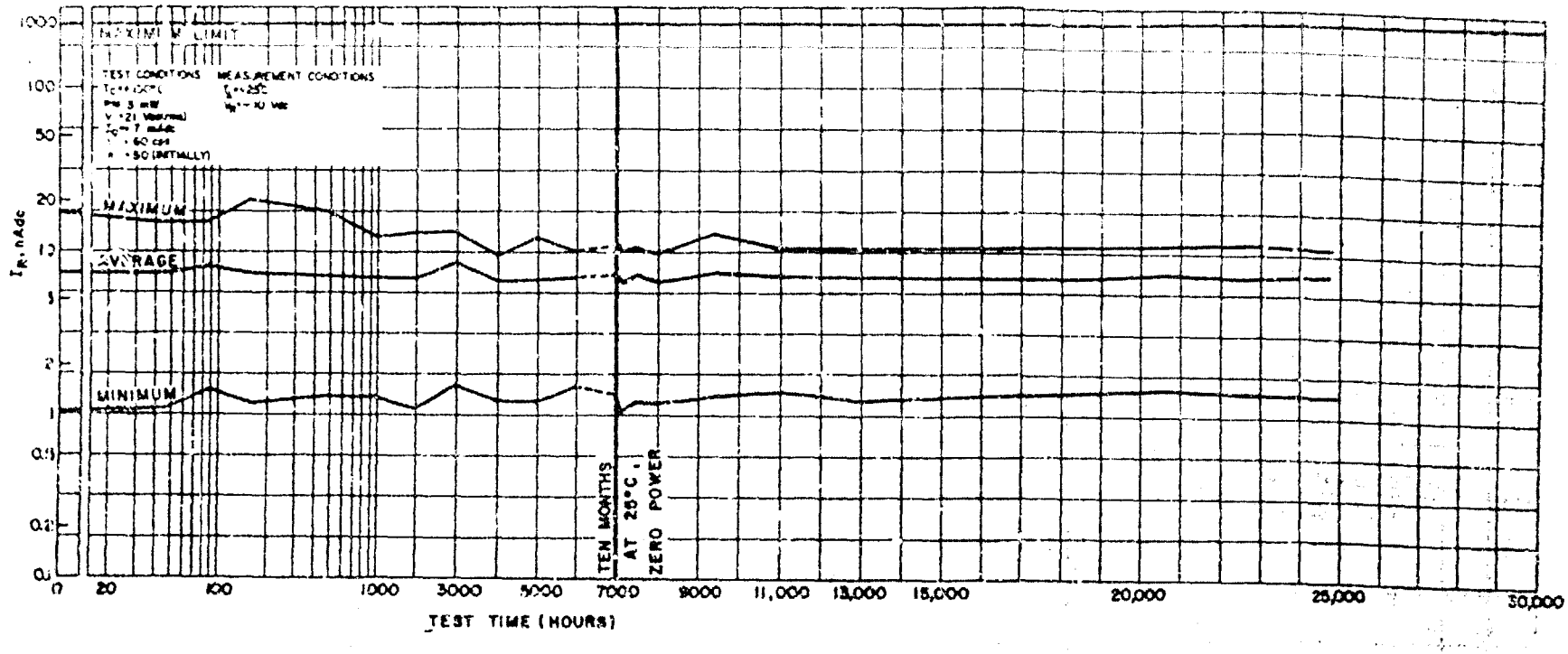
PH 4 R2010P1 VF MATRIX OF VF VALUES IN VOLTS

49 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.660	0.016	0.633	0.720
24.	0.660	0.016	0.636	0.721
48.	0.659	0.017	0.634	0.720
96.	0.662	0.016	0.636	0.721
168.	0.667	0.022	0.635	0.853
360.	0.665	0.029	0.632	0.769
504.	0.661	0.016	0.635	0.722
1008.	0.660	0.019	0.634	0.719
1512.	0.661	0.023	0.633	0.706
2008.	0.659	0.024	0.636	0.770
2488.	0.662	0.022	0.638	0.732
3016.	0.666	0.029	0.643	0.743
3520.	0.664	0.025	0.642	0.765
4050.	0.664	0.025	0.631	0.758
4528.	0.662	0.018	0.635	0.720
5032.	0.659	0.018	0.636	0.719
5536.	0.658	0.017	0.633	0.707
6040.	0.667	0.025	0.639	0.773
6544.	0.667	0.026	0.639	0.762
6952.	0.670	0.032	0.639	0.833
7119.	0.655	0.026	0.636	0.739
7449.	0.669	0.035	0.635	0.816
7946.	0.664	0.027	0.634	0.813
8007.	0.663	0.030	0.633	0.813

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
1	4050	1

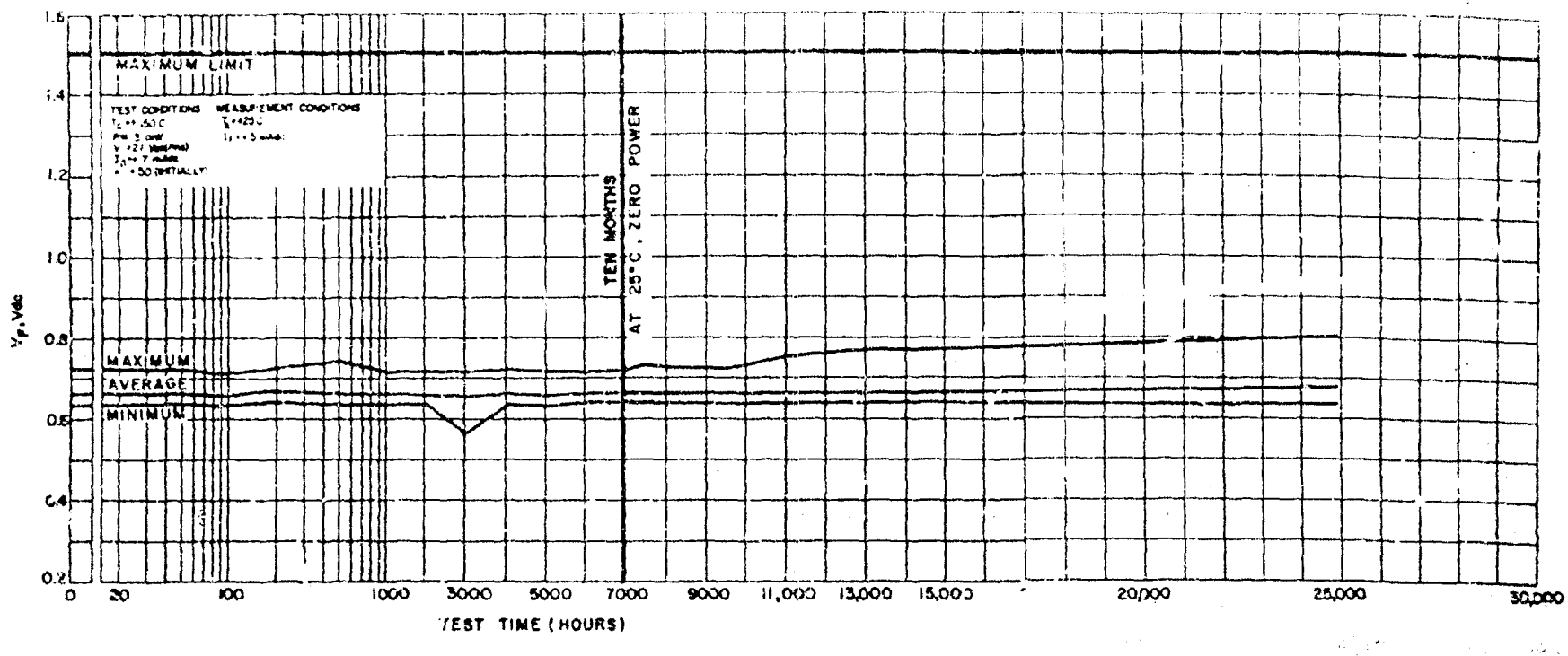
Figure 3-43. Parameter Trend Chart, R2010P1 Phase JV, V_F



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	7.498	2.465	1.050	16.400
48.	7.191	1.919	1.100	11.900
96.	7.058	2.362	1.450	13.500
168.	6.998	1.636	1.200	10.033
504.	6.967	1.718	1.350	9.350
1010.	6.962	1.806	1.200	10.000
1993.	6.904	1.647	1.100	9.000
2998.	6.857	2.263	1.500	13.200
3998.	6.463	1.726	1.200	9.400
4998.	6.429	1.711	1.200	9.200
5998.	6.749	1.824	1.500	9.800
7048.	7.034	1.702	1.200	10.000
7198.	6.546	1.659	1.050	8.900
7492.	7.043	1.757	1.200	9.700
8871.	6.589	1.618	1.200	9.500
9497.	7.215	1.808	1.300	9.900
11883.	7.282	1.779	1.400	9.700
12994.	7.413	1.953	1.200	10.200
14934.	7.259	1.847	1.300	10.000
16519.	7.147	1.792	1.400	10.000
17[illegible].	7.038	1.811	1.000	11.200
20549.	6.998	1.787	1.300	10.500
22741.	7.111	1.879	1.500	12.000
24784.	7.092	1.876	1.400	11.900

No Failures

Figure 3-44. Parameter Trend Chart, R2010P1 Phase V, I_R, Group I



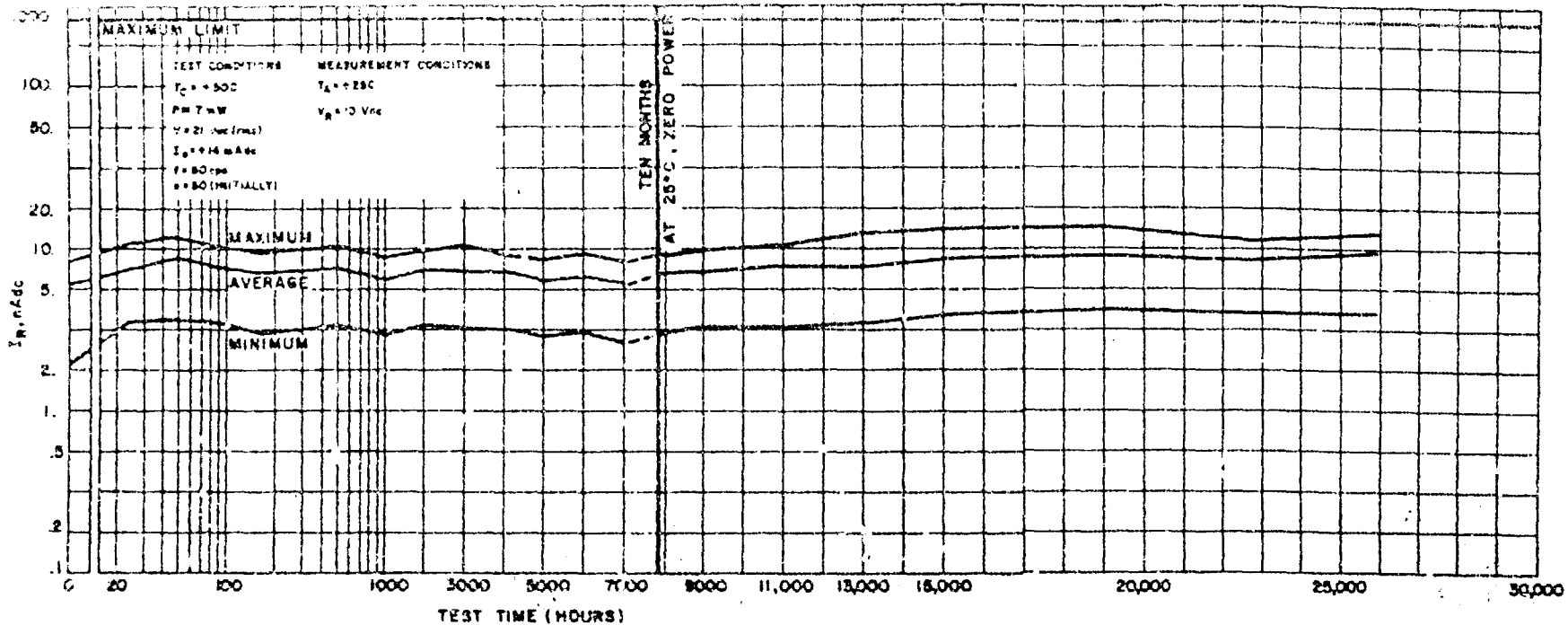
PHASE B R2010P1 VF — VF VALUES IN VOLTS

47 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.663	0.014	0.637	0.726
12.	0.666	0.017	0.641	0.729
48.	0.658	0.015	0.636	0.718
168.	0.661	0.017	0.638	0.721
336.	0.666	0.019	0.639	0.727
1680.	0.662	0.017	0.639	0.719
1992.	0.662	0.016	0.640	0.718
2998.	0.659	0.020	0.637	0.716
3996.	0.661	0.014	0.639	0.720
4992.	0.659	0.015	0.642	0.719
5992.	0.665	0.016	0.642	0.719
6988.	0.668	0.018	0.645	0.722
7168.	0.665	0.017	0.642	0.723
7480.	0.668	0.020	0.642	0.730
8064.	0.667	0.018	0.643	0.724
9144.	0.668	0.016	0.643	0.721
11664.	0.671	0.021	0.647	0.727
12984.	0.668	0.019	0.642	0.724
14328.	0.668	0.020	0.642	0.723
16152.	0.667	0.020	0.641	0.720
16477.	0.670	0.020	0.644	0.724
19349.	0.672	0.022	0.642	0.727
22141.	0.674	0.023	0.643	0.732
24784.	0.683	0.026	0.644	0.738

No Failures

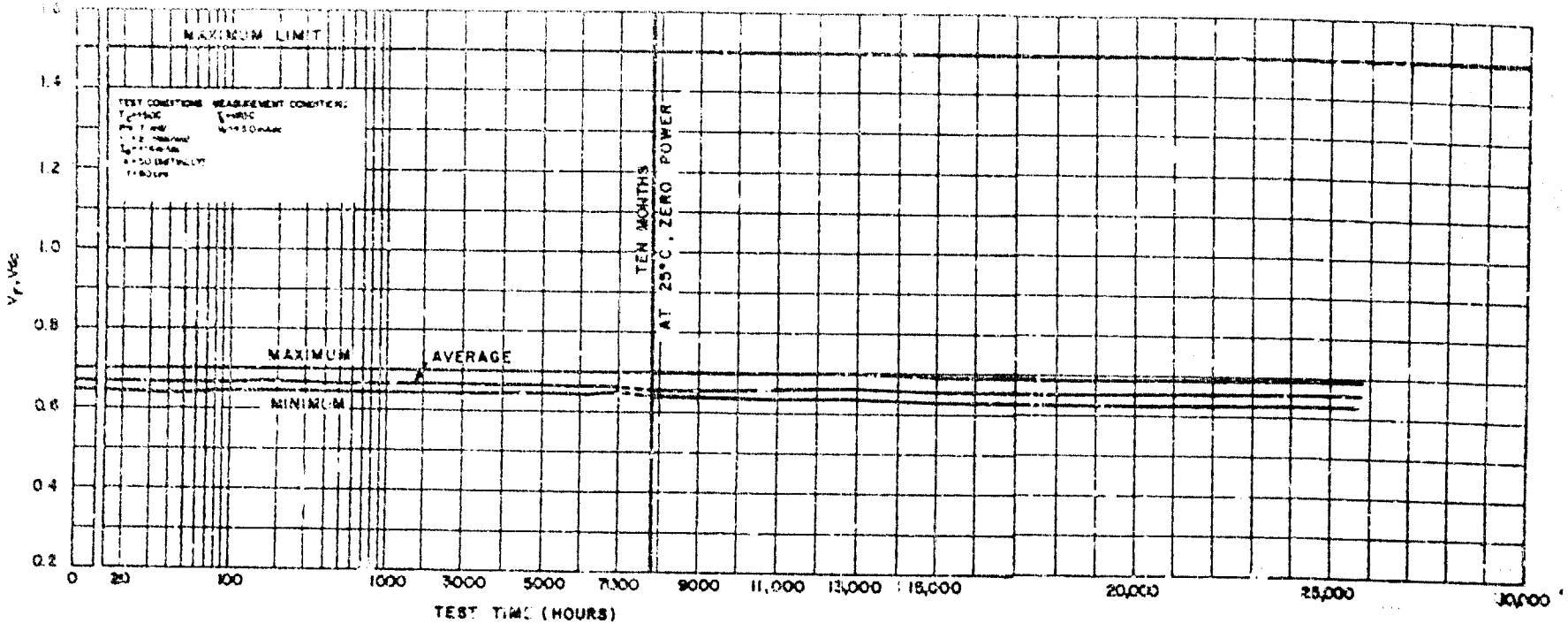
Figure 3-45. Parameter Trend Chart R2010P1 Phase V, V_F, Group I



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	6,288	1,669	3,888	8,688
24	7,612	1,626	3,888	11,088
48	6,847	2,168	2,881	15,960
96	7,018	1,649	3,681	10,188
168	7,184	1,567	3,48	9,888
264	6,838	1,717	3,888	10,268
1854	6,766	1,183	3,881	9,888
2688	7,769	1,581	3,488	9,988
3696	7,437	1,586	3,288	10,888
4824	7,386	1,637	3,388	9,988
5808	6,783	1,489	3,888	8,888
6835	6,984	1,612	3,181	9,788
7830	6,264	1,886	3,788	8,468
7854	7,252	1,913	4,188	9,388
1992	7,176	1,516	3,888	9,888
6859	7,694	1,316	3,988	10,388
10933	8,060	1,888	3,488	11,888
12925	8,292	1,912	3,488	12,488
13945	8,732	1,999	3,988	12,838
18778	9,326	2,288	4,188	14,998
22471	8,464	1,887	3,888	11,288
25994	8,934	1,832	3,888	11,188

No Failures

Figure 3-46. Parameter Trend Chart R2010P1 Phase VI, I_R



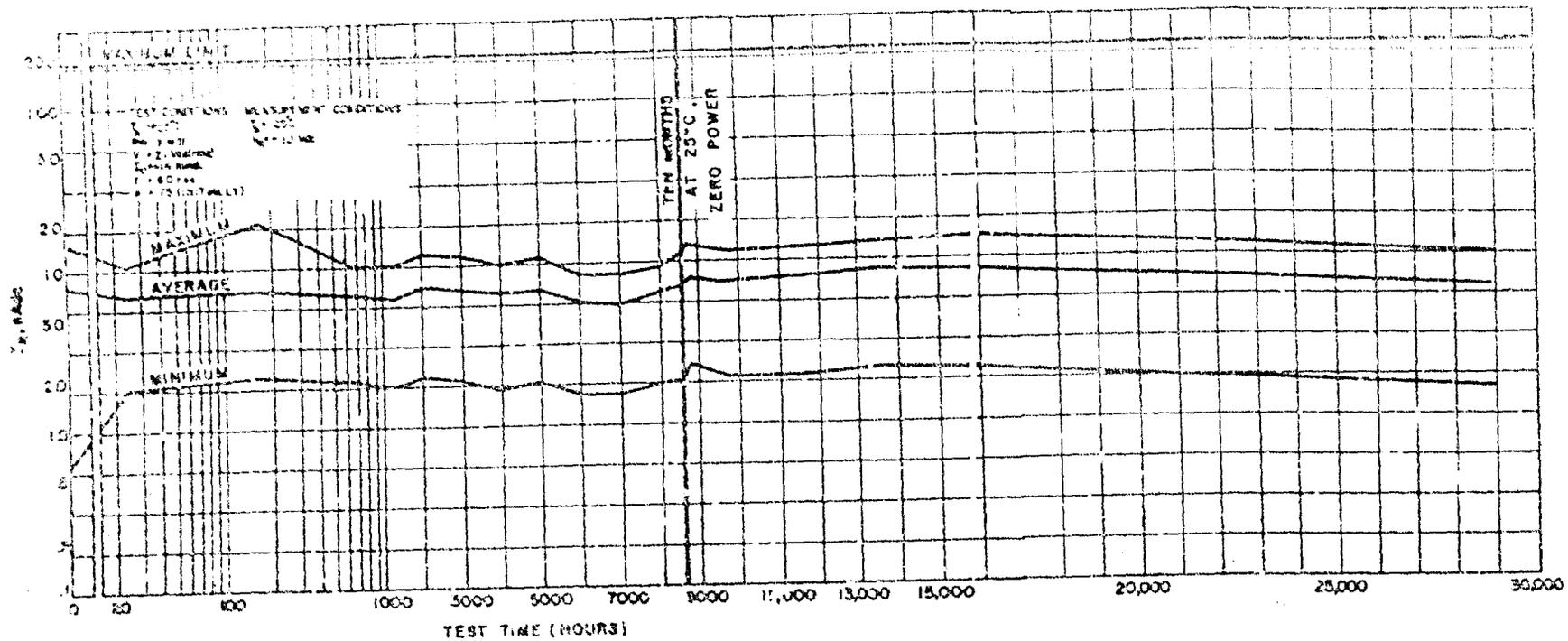
PW 6 R2010P1 VF

V_F VALUES IN VOLTS

TEST HOURS	96 PARTS AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	0.663	0.015	0.641	0.696
24	0.662	0.013	0.639	0.693
48	0.663	0.012	0.639	0.699
96	0.664	0.012	0.641	0.702
168	0.666	0.013	0.642	0.699
504	0.665	0.012	0.642	0.699
1008	0.664	0.012	0.640	0.699
1680	0.663	0.013	0.641	0.701
3000	0.663	0.013	0.640	0.695
4008	0.664	0.012	0.641	2.696
5016	0.664	0.012	0.641	0.696
6120	0.663	0.012	0.639	0.699
7320	0.667	0.012	0.640	0.700
7864	0.667	0.012	0.636	0.694
8592	0.669	0.012	0.638	0.693
8690	0.666	0.013	0.633	0.691
10023	0.668	0.013	0.638	0.693
12023	0.669	0.013	0.636	0.693
14344	0.668	0.013	0.638	0.699
16776	0.667	0.013	0.636	0.692
22473	0.667	0.012	0.636	0.696
25596	0.665	0.013	0.638	0.695

No Failures

Figure 3-47. Parameter Trend Chart R2010P1 Phase VI, V_F



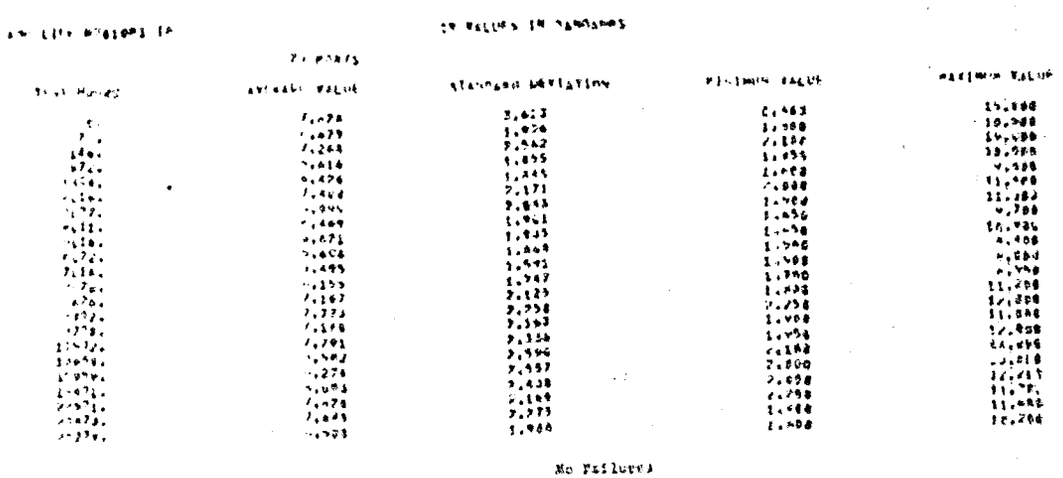
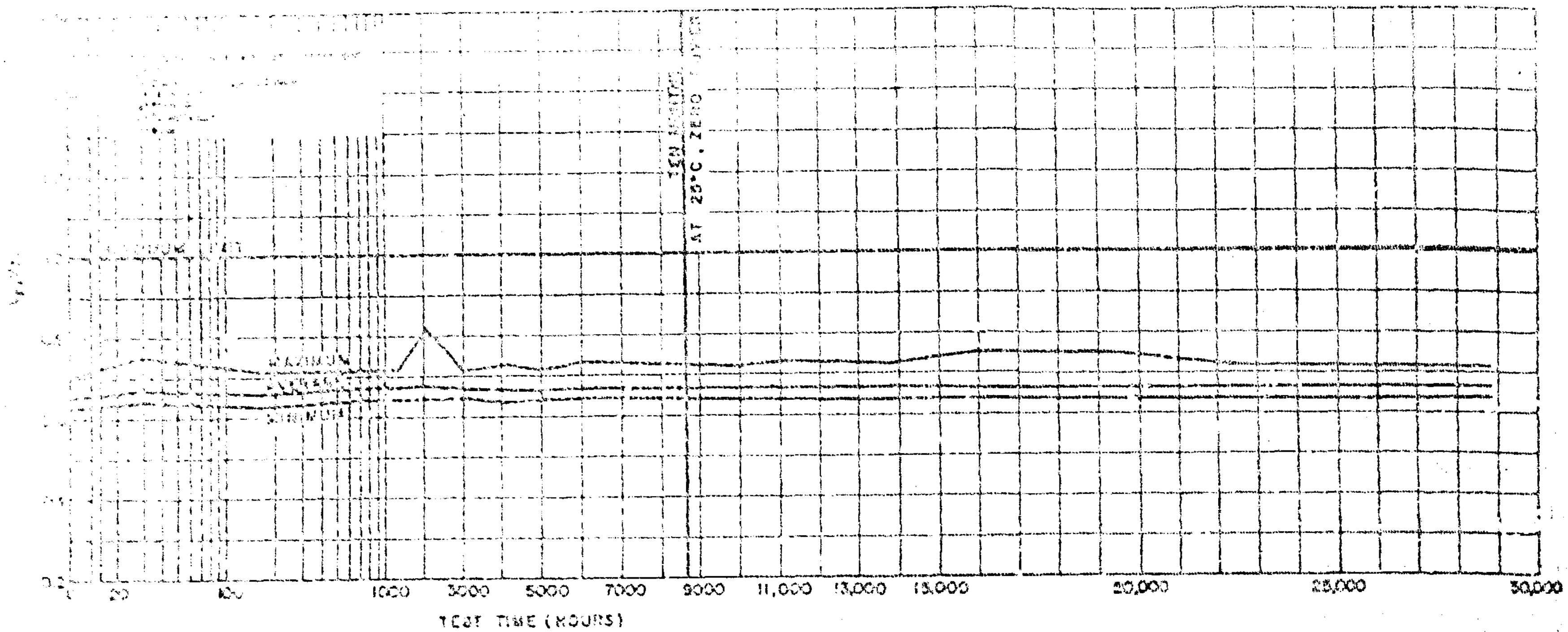
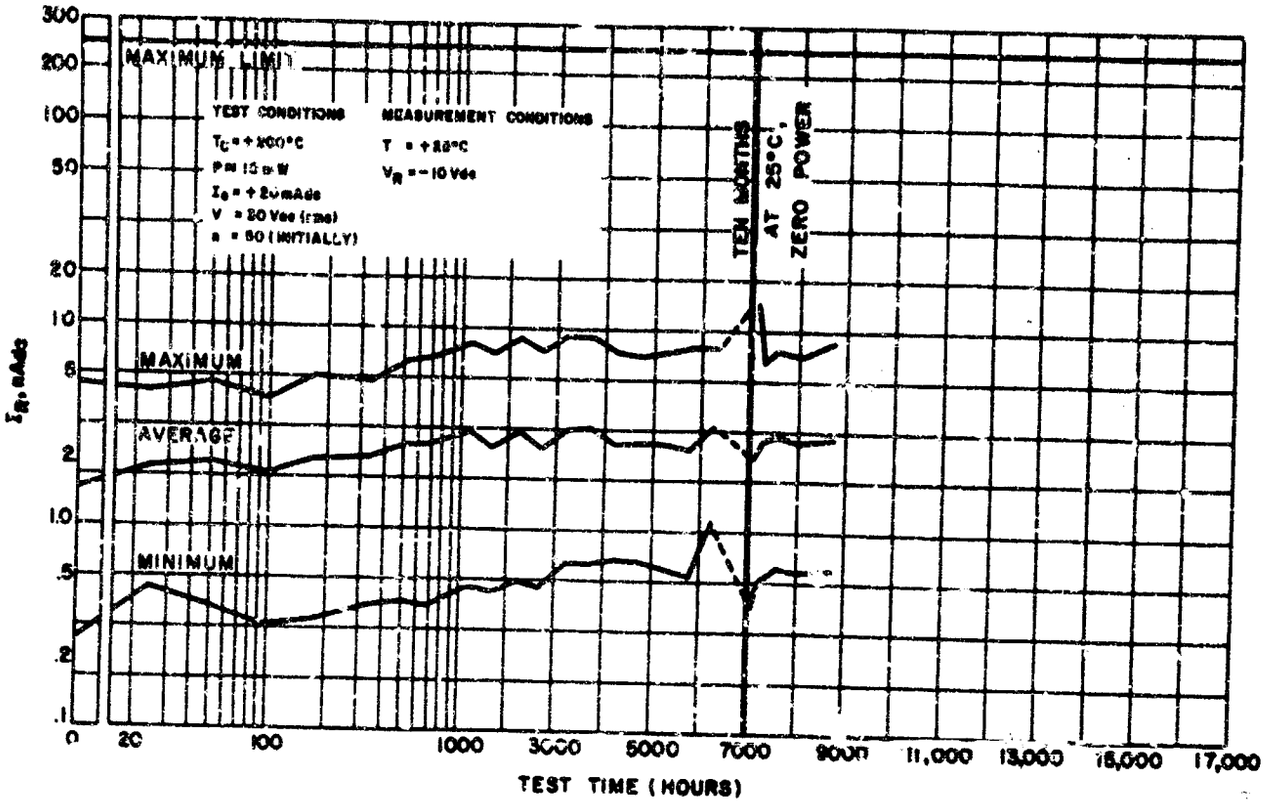


Figure 3-48. Parameter Trend Chart R2010P1 Ambient Life, I_R



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 3-[illegible]. Parameter Trend Chart R0910P: Ambient Life, V_F



PH 4 R2011P1 IR

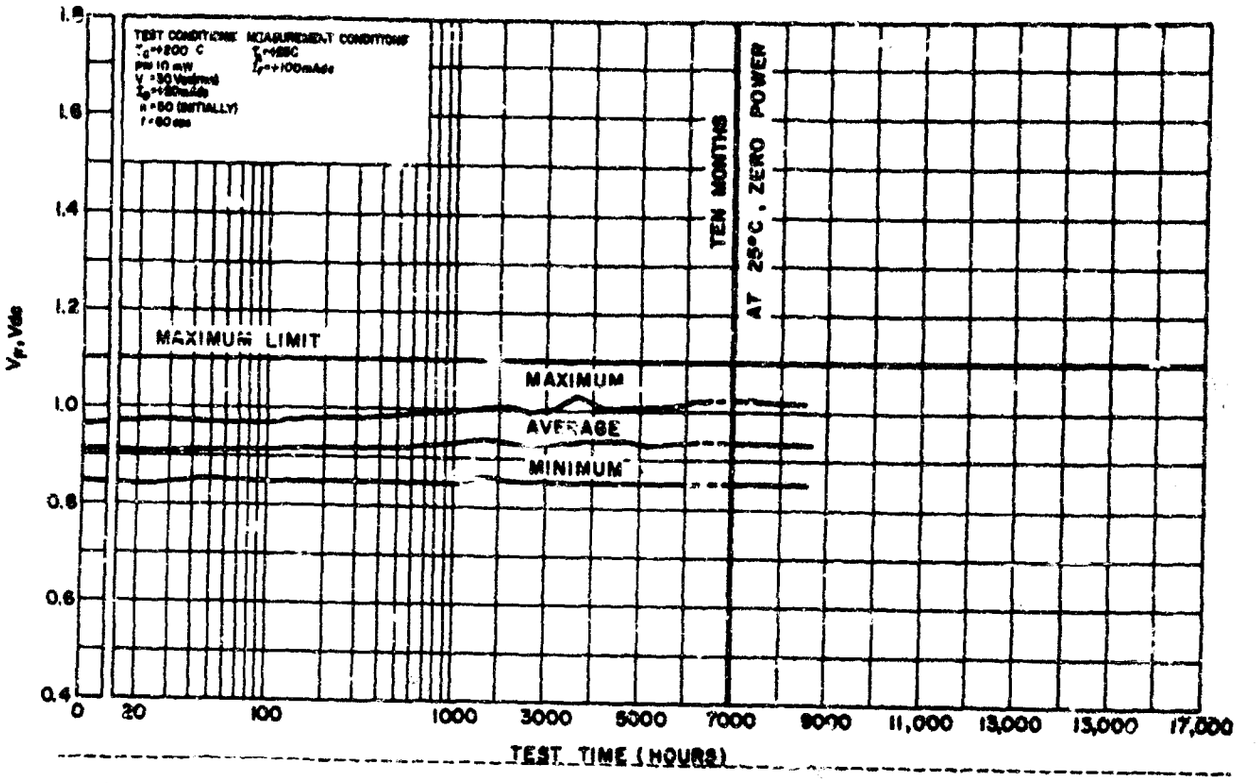
IR VALUES IN NANOAMPS

44 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	1.488	0.900	0.260	4.820
24.	1.962	0.954	0.490	4.720
48.	2.143	1.083	0.400	5.000
96.	1.882	0.948	0.320	4.430
168.	2.287	1.229	0.390	5.800
336.	2.345	1.261	0.420	5.800
504.	2.602	1.436	0.430	6.600
672.	2.700	1.395	0.430	7.200
1176.	2.655	1.789	0.310	8.300
1596.	2.717	1.623	0.480	7.000
2184.	3.118	1.830	0.550	8.900
2688.	2.637	1.579	0.520	7.800
3192.	3.310	1.909	0.490	9.600
3696.	3.416	1.926	0.700	9.300
4198.	2.629	1.500	0.700	7.700
4702.	2.932	1.617	0.710	7.650
5217.	2.910	1.527	0.650	7.700
5710.	2.717	1.598	0.600	8.200
6214.	3.406	1.972	1.150	8.400
7020.	2.436	1.453	0.450	14.200
7167.	2.925	1.581	0.580	7.600
7527.	3.077	1.699	0.680	8.300
8624.	2.905	1.562	0.650	7.900
8685.	3.096	1.668	0.670	9.000

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
4	1176	1
	7020	1
	7587	1
	8624	1

Figure 3-50. Parameter Trend Chart R2011P1, Phase IV, I_R



PH 4 R2011P1 VF — MATRIX OF VF VALUES IN VOLTS — 44 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.913	0.038	0.850	0.960
24.	0.916	0.038	0.845	0.971
48.	0.917	0.037	0.853	0.974
96.	0.916	0.038	0.852	0.975
168.	0.922	0.037	0.857	0.980
336.	0.924	0.037	0.859	0.981
504.	0.928	0.038	0.859	0.989
672.	0.927	0.039	0.857	0.989
1176.	0.927	0.039	0.857	0.990
1680.	0.931	0.043	0.860	0.998
2184.	0.929	0.043	0.853	1.000
2688.	0.932	0.041	0.858	1.010
3192.	0.931	0.042	0.856	0.999
3697.	0.933	0.044	0.853	1.000
4196.	0.934	0.043	0.858	1.010
4702.	0.935	0.044	0.858	1.009
5217.	0.932	0.045	0.854	1.007
5716.	0.934	0.048	0.849	1.009
6214.	0.938	0.047	0.849	1.010
7030.	0.936	0.046	0.853	1.023
7197.	0.937	0.044	0.859	1.021
7527.	0.934	0.047	0.850	1.020
8024.	0.936	0.047	0.853	1.020
8685.	0.937	0.046	0.849	1.015

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
4	1176	1
	7680	1
	7527	1
	8024	1

Figure 3-51. Parameter Trend Chart R2011P1, Phase IV, V_F

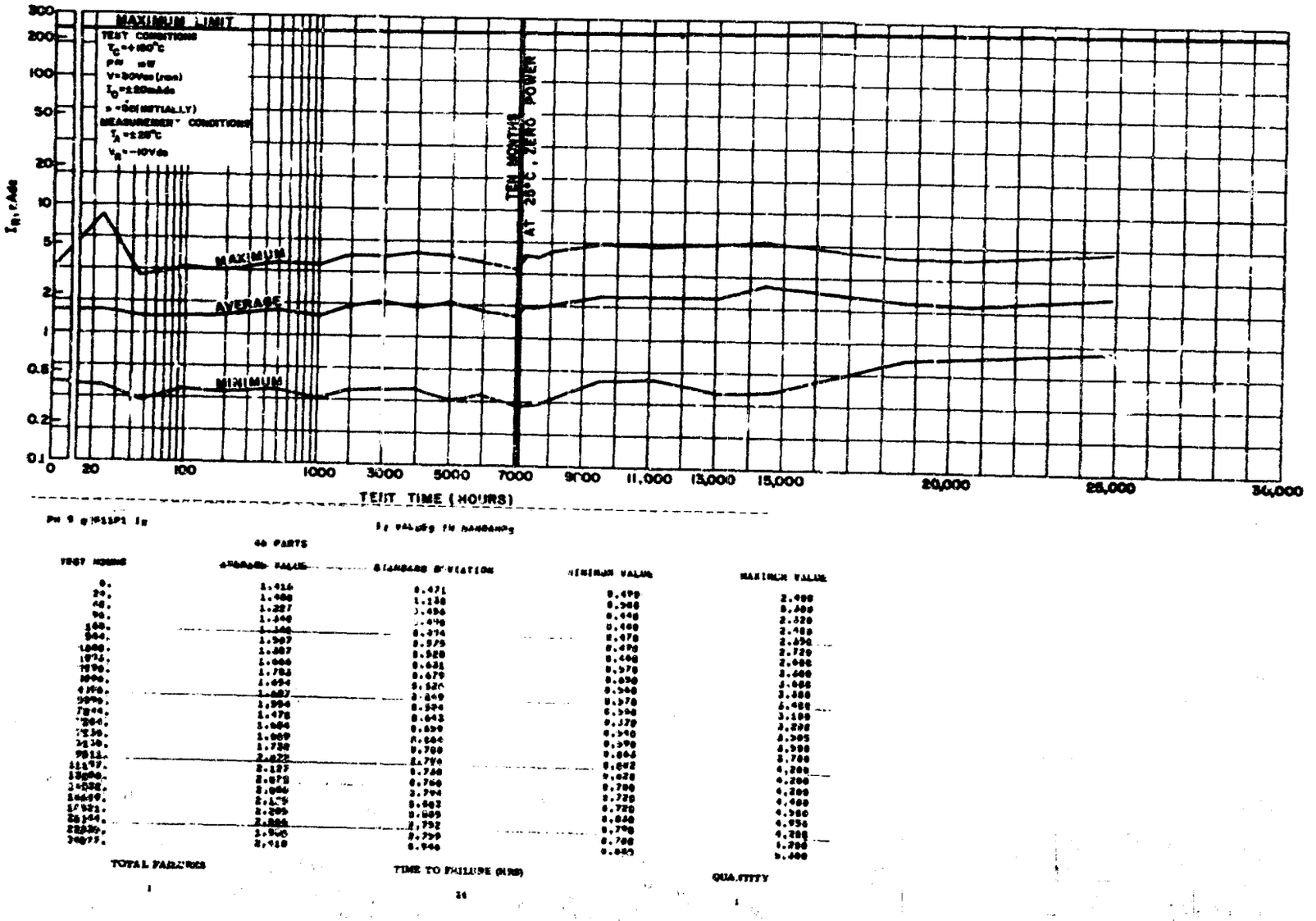
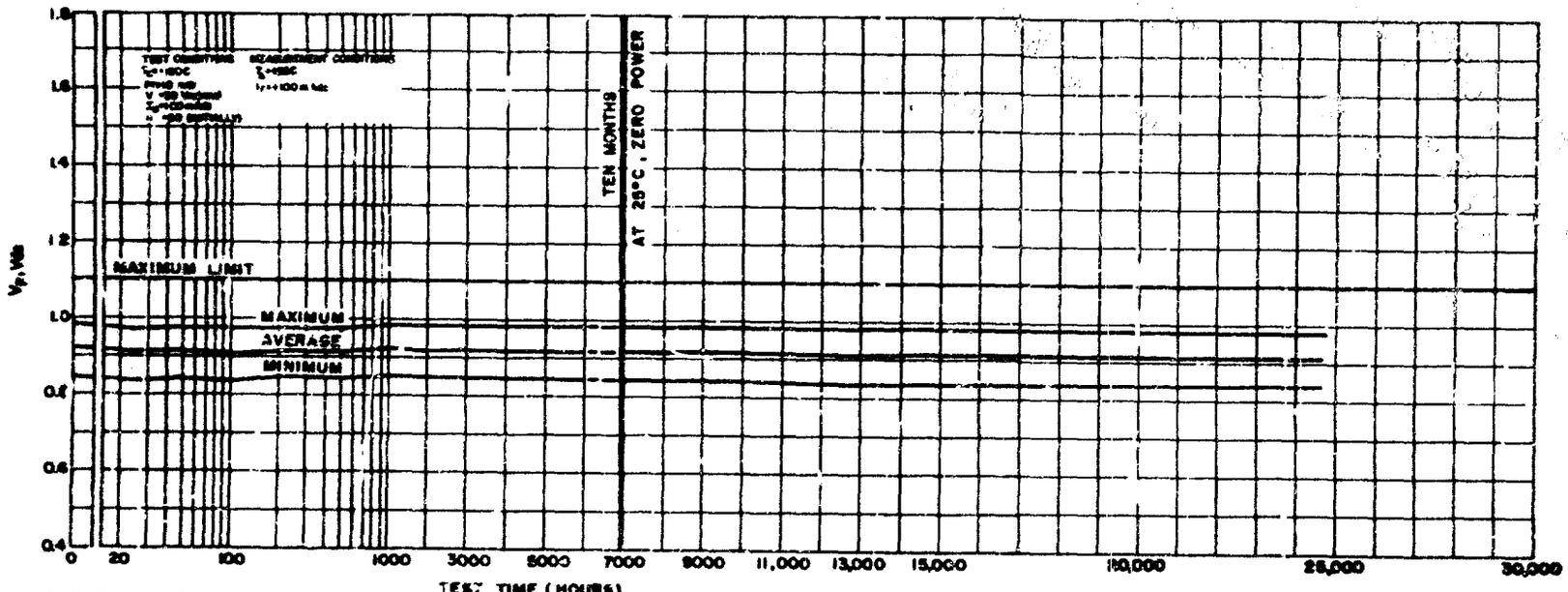
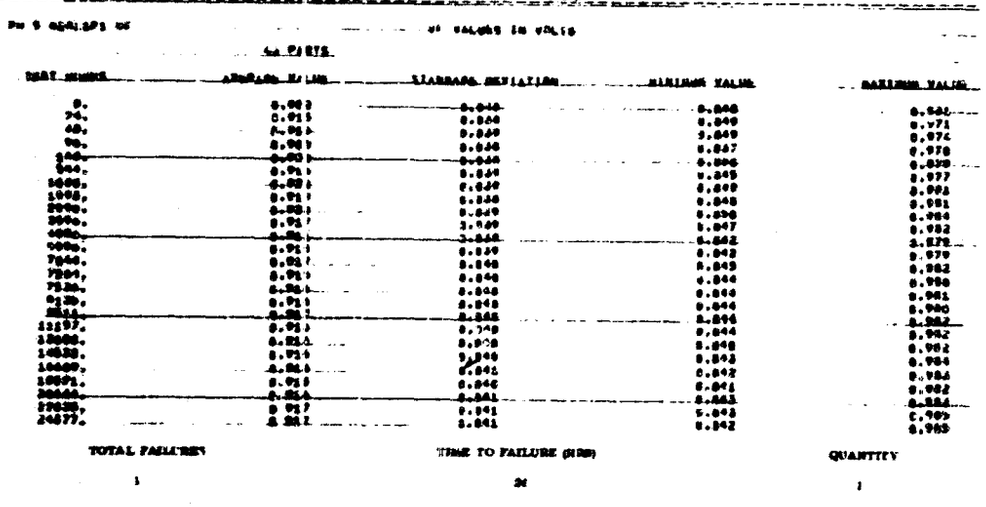


Figure 3-52. Parameter Trend Chart R2011P1, Phase V, I_R

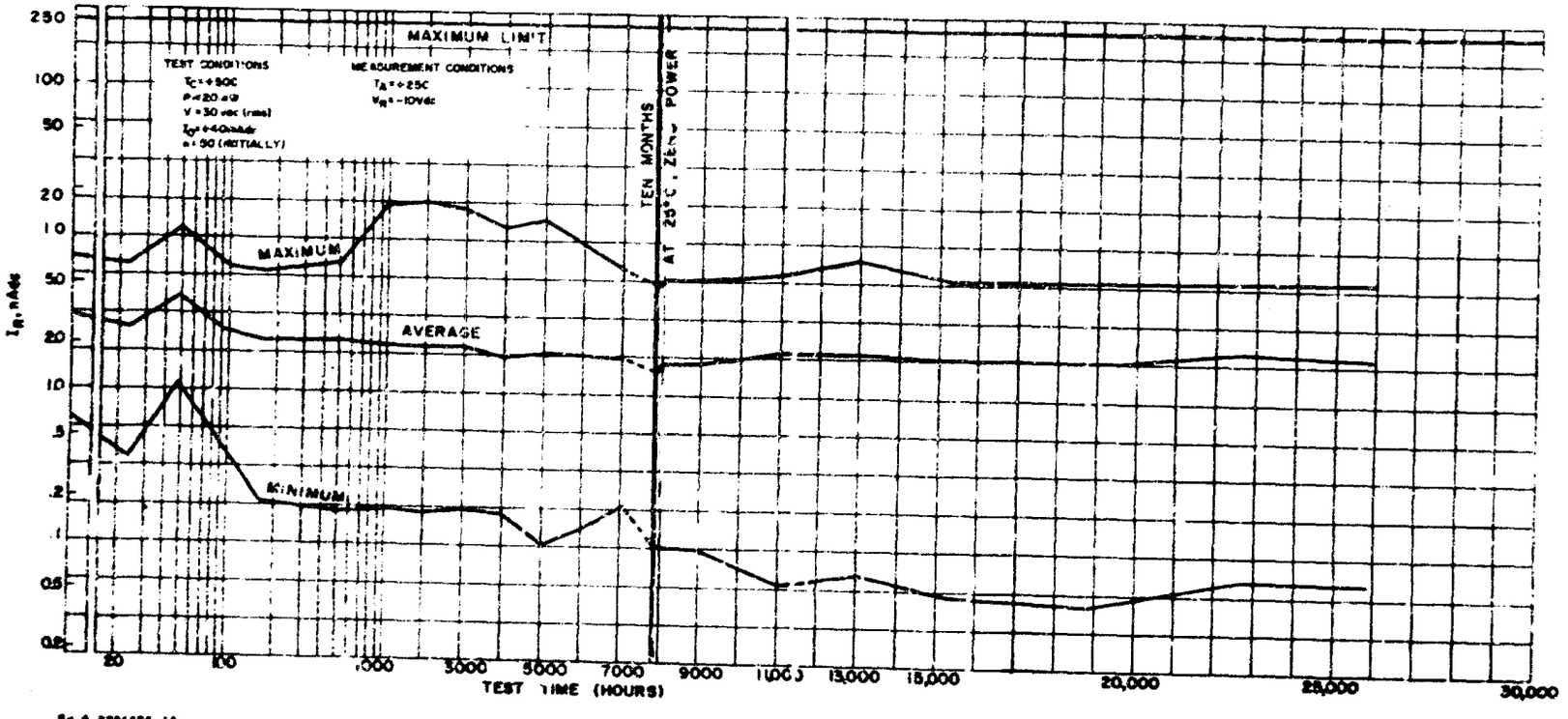




TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.983	0.040	0.868	0.941
24.	0.915	0.050	0.849	0.971
48.	0.913	0.049	0.849	0.974
96.	0.913	0.048	0.847	0.978
168.	0.913	0.048	0.846	0.979
344.	0.911	0.049	0.845	0.977
1000.	0.913	0.049	0.849	0.981
1848.	0.911	0.048	0.848	0.981
2520.	0.913	0.049	0.850	0.984
3000.	0.911	0.049	0.847	0.982
4000.	0.914	0.048	0.852	0.979
5000.	0.911	0.049	0.842	0.979
7040.	0.913	0.048	0.843	0.982
7304.	0.911	0.048	0.844	0.980
7520.	0.914	0.048	0.844	0.981
8230.	0.911	0.048	0.844	0.980
8544.	0.913	0.048	0.844	0.982
11157.	0.911	0.049	0.844	0.982
13000.	0.914	0.048	0.843	0.982
14520.	0.911	0.049	0.843	0.984
16000.	0.914	0.048	0.842	0.984
18001.	0.913	0.048	0.841	0.982
20000.	0.914	0.048	0.843	0.984
21520.	0.913	0.048	0.843	0.985
24077.	0.912	0.048	0.842	0.985

TOTAL FAILURES: 1 — TIME TO FAILURE (HRS): 24 — QUANTITY: 1

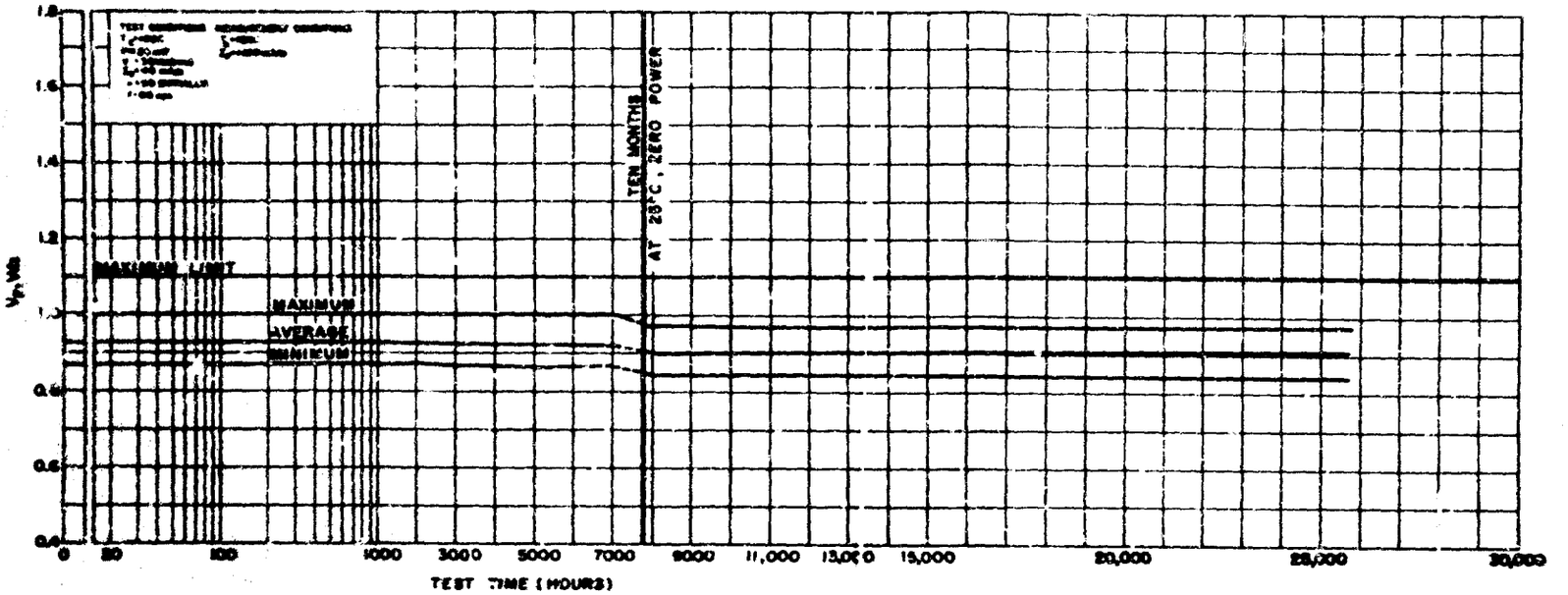
Figure 3-53. Parameter Trend Chart R2011P1, Phase V, V_F



TEST HOURS	98 PACTS AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	4,328	1,589	0,728	7,100
24	2,304	1,594	0,308	6,200
48	4,056	1,982	1,488	11,500
96	2,168	1,679	0,498	6,500
168	3,460	2,462	0,188	6,500
504	2,194	1,575	0,188	6,000
1000	2,230	2,466	0,178	6,800
2000	2,881	2,546	0,188	16,500
3000	2,339	2,340	0,178	17,200
4000	1,784	1,884	0,198	19,500
5000	4,006	2,048	0,198	18,200
6000	1,759	1,566	0,188	18,700
7000	1,768	1,312	0,198	9,400
8000	1,410	1,258	0,198	6,700
9000	1,948	1,348	0,188	5,300
10000	1,674	1,372	0,188	5,700
11000	1,668	1,509	0,188	5,300
12000	1,934	1,720	0,868	6,200
13000	1,914	1,613	0,878	7,700
14000	1,931	1,944	0,838	6,100
15000	3,158	1,381	0,878	6,100
20000	1,799	1,589	0,448	6,100
			0,848	6,100

No Failures

Figure 3-54. Parameter Trend Chart R2011P*, Phase VI, I_R



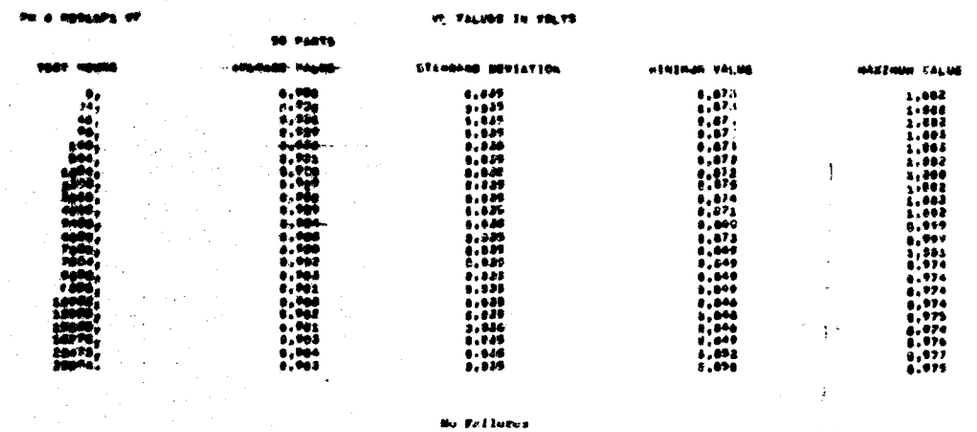


Figure 3-55. Parameter Trend Chart R2011P1, Phase VI, V_F

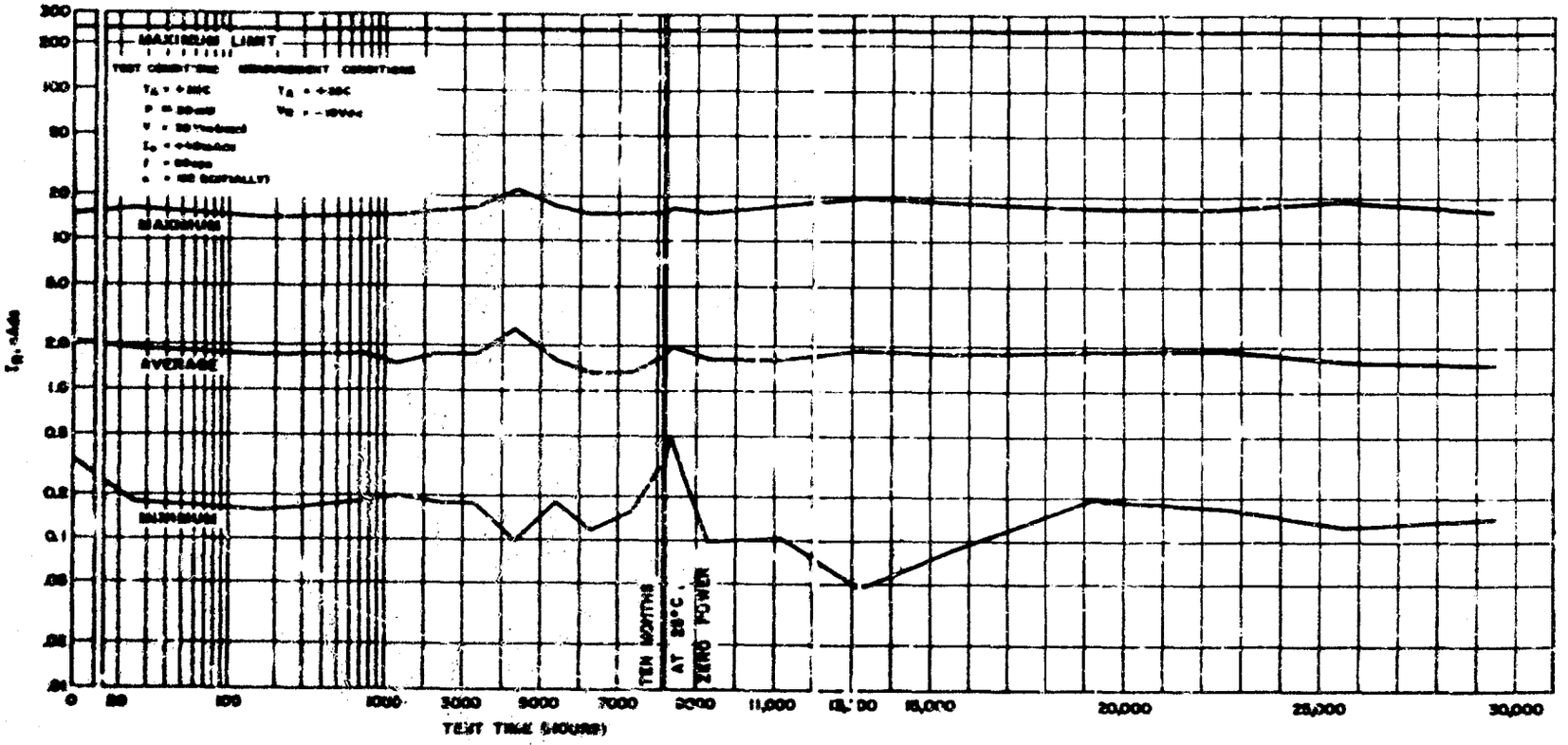


Figure 3-56. Parameter Trend Chart A2011P1, Ambient Life, I_R, Group I

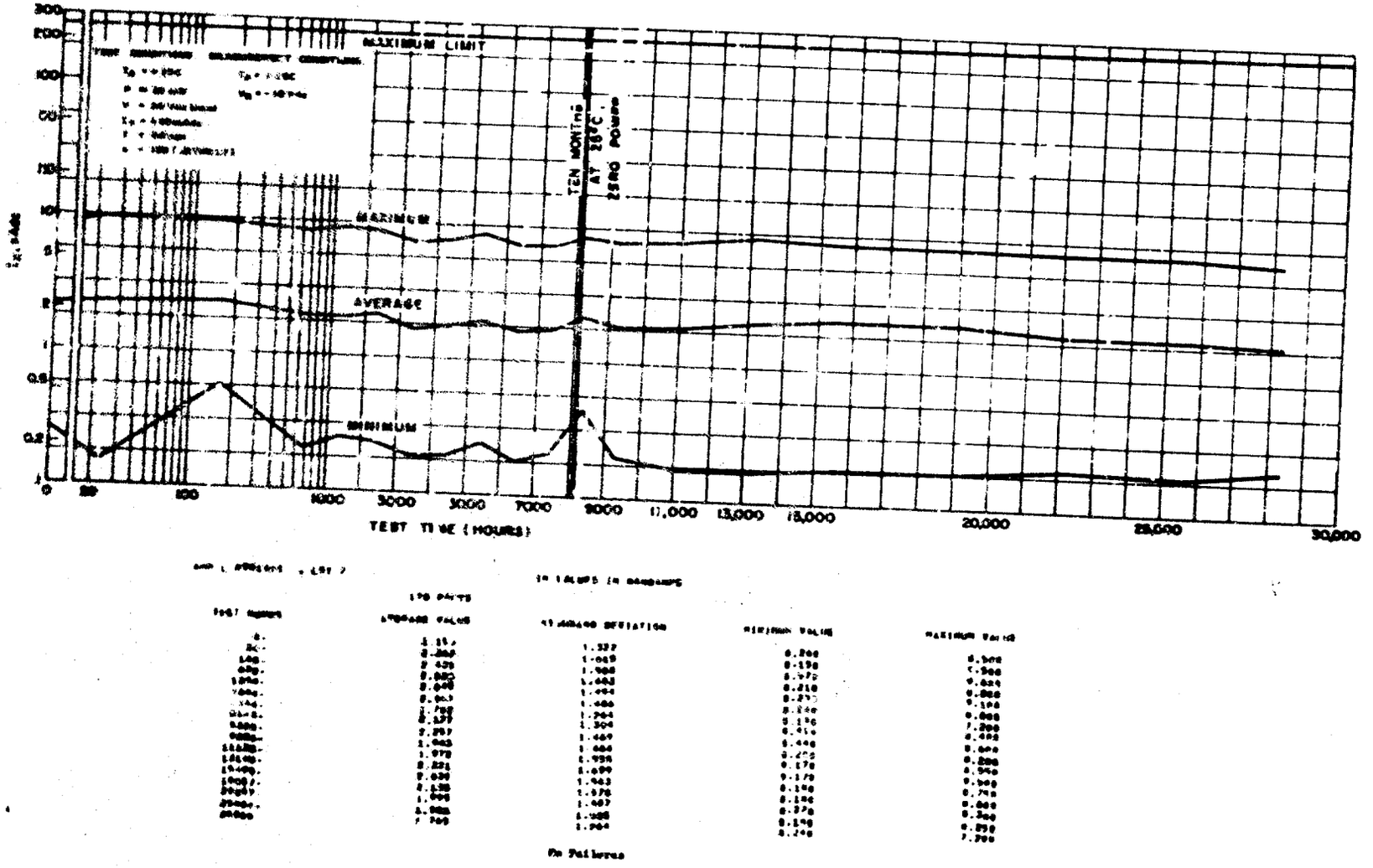


Figure 3-57. Parameter Trend Chart R2011F1, Ambient Life, I_R, Group II

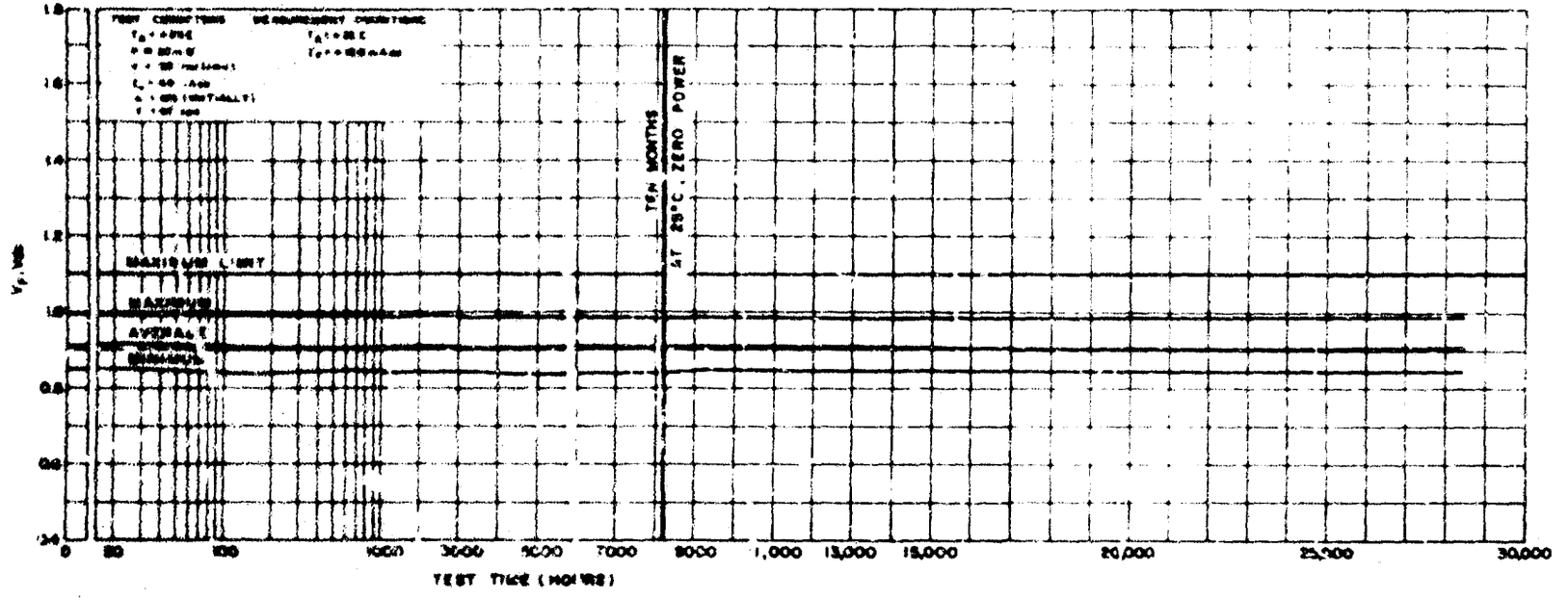


Figure 3-58. Parameter Trend Chart R2011P1, Ambient Life, V_F, Group I

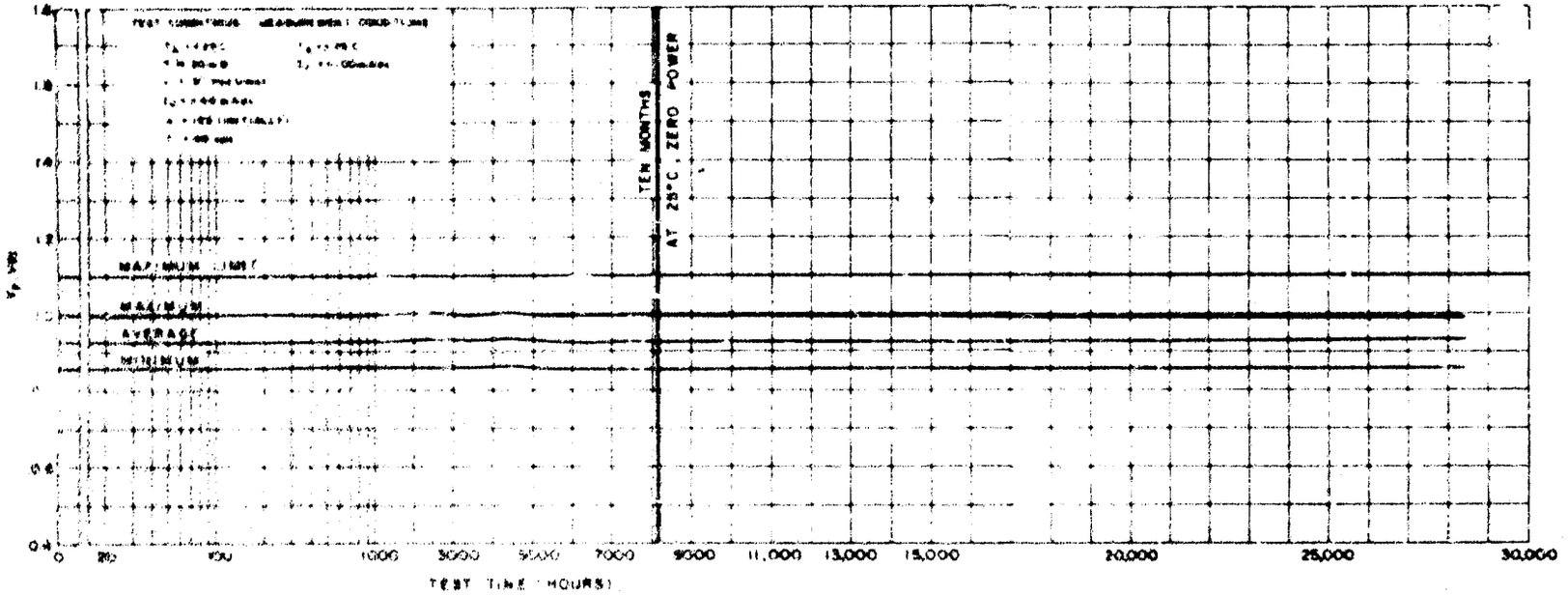
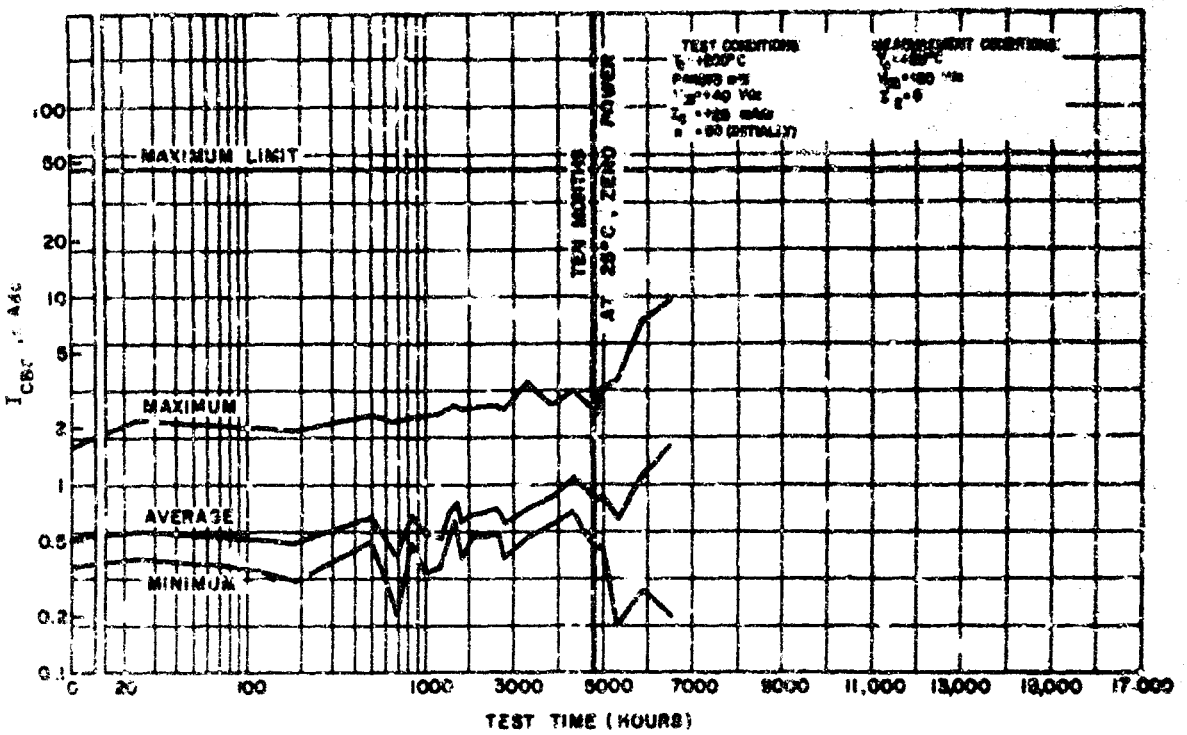


Figure 3-59. Parameter Trend Chart R2011P1, Ambient Life V_F, Group II



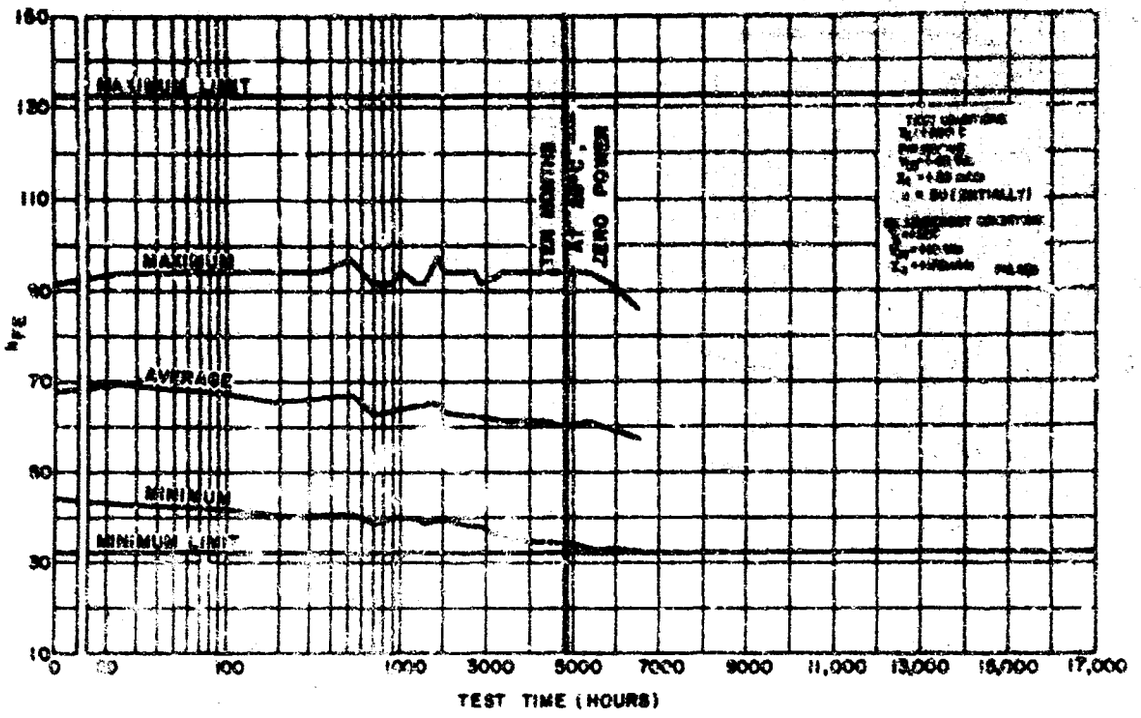
PH 4 R2004P1 ICHC

ICHO VALUES IN NANOAMPS

TEST HOURS	78 PARTS AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.936	0.225	0.576	1.600
24.	0.969	0.330	0.480	2.200
48.	0.919	0.316	0.378	2.000
168.	0.490	0.288	0.210	1.990
312.	0.481	0.358	0.414	2.000
504.	0.485	0.346	0.216	2.400
672.	0.427	0.367	0.216	2.200
840.	0.595	.347	0.498	2.350
1008.	0.549	0.372	0.348	2.300
1344.	0.561	0.574	0.300	2.400
1512.	0.560	0.373	0.478	2.900
1680.	0.833	0.370	0.636	2.350
1849.	0.561	0.388	0.429	2.400
4817.	0.760	0.376	0.378	2.350
2688.	0.771	0.393	0.558	2.600
2520.	0.610	0.367	0.480	2.400
3024.	0.753	0.352	0.543	2.400
3867.	0.849	.614	0.600	2.650
4536.	1.183	0.682	0.720	3.200
4877.	0.862	0.467	0.444	2.400
4954.	0.884	0.688	0.468	3.200
5376.	0.965	0.776	0.178	3.600
5881.	1.001	0.628	0.270	2.900
6402	1.097	0.854	0.288	3.800

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
21	504	1
	1008	1
	1848	1
	3187	2
	3528	1
	3648	2
	5760	1
	5906	2
	5887	2
	6384	3
	6984	1
	6871	1
	6402	1

Figure 3-60. Parameter Trend Chart, R2004P1, Phase IV, I_{CBO}



PN 4 97 9453 X/X

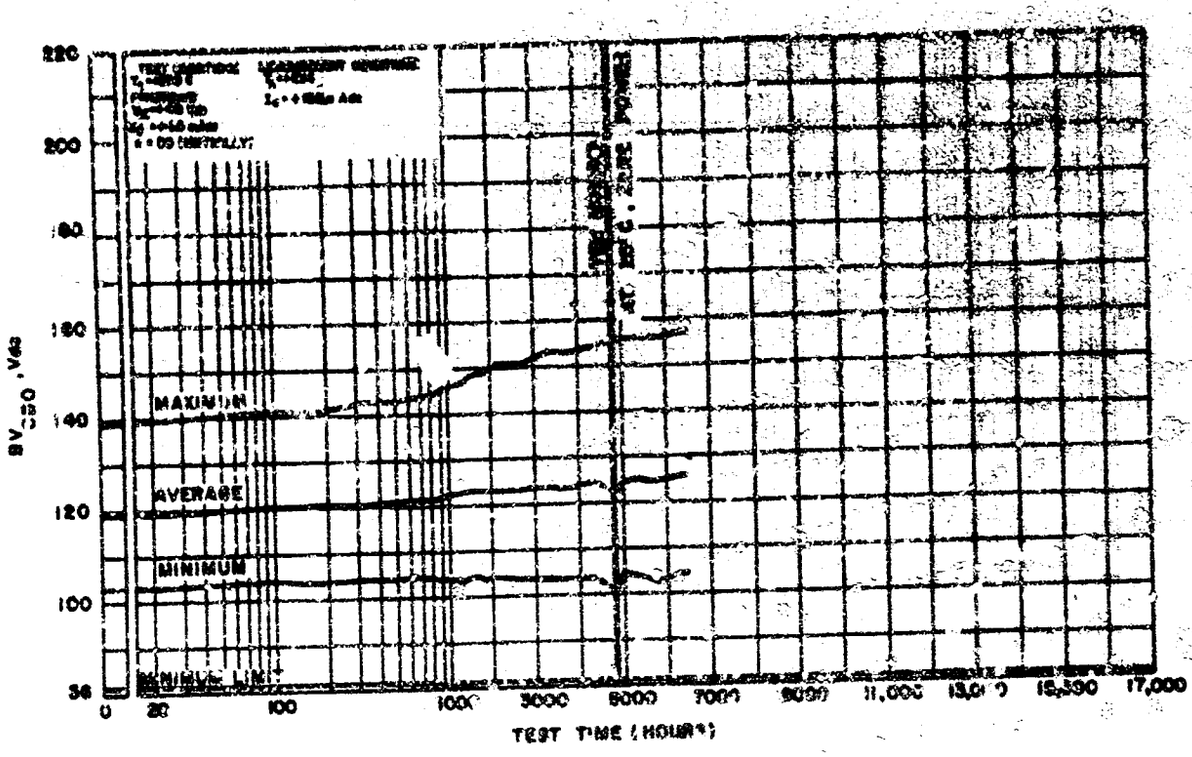
hFE VALUES

20 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	66.875	14.662	44.188	91.000
24.	69.162	14.743	42.900	95.800
96.	67.457	14.843	41.700	92.800
168.	65.318	14.692	40.088	93.888
337.	66.446	14.738	40.588	93.838
504.	66.664	14.997	40.588	94.678
672.	63.475	14.751	38.908	91.838
840.	63.679	14.756	39.588	91.689
1008.	64.464	14.499	39.960	93.888
1344.	64.943	14.403	39.988	91.888
1512.	64.879	14.536	38.588	91.866
1680.	65.080	14.659	39.888	93.868
1849.	64.789	15.011	39.800	94.860
2017.	63.393	13.594	39.888	93.490
2688.	62.929	13.987	37.988	93.648
2700.	61.743	13.888	37.568	90.900
3363.	61.490	14.463	36.388	93.888
3867.	61.857	14.222	34.988	94.888
4204.	61.179	14.172	34.988	93.088
4872.	59.088	14.188	34.188	93.788
4994.	58.808	13.923	34.888	93.788
5324.	60.993	15.675	32.209	93.768
5371.	59.296	14.961	32.888	91.688
6682.	7.144	10.898	31.388	89.768

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
21	504	1
	1488	1
	1848	1
	2187	2
	3688	1
	3819	3
	3788	1
	3785	3
	3867	2
	4204	2
	4884	1
	5871	1
	6638	1

Figure 3-61. Parameter Trend Chart, R2004P1, Phase IV, h_{FE}



FN 4 R2004P1 BVCBO

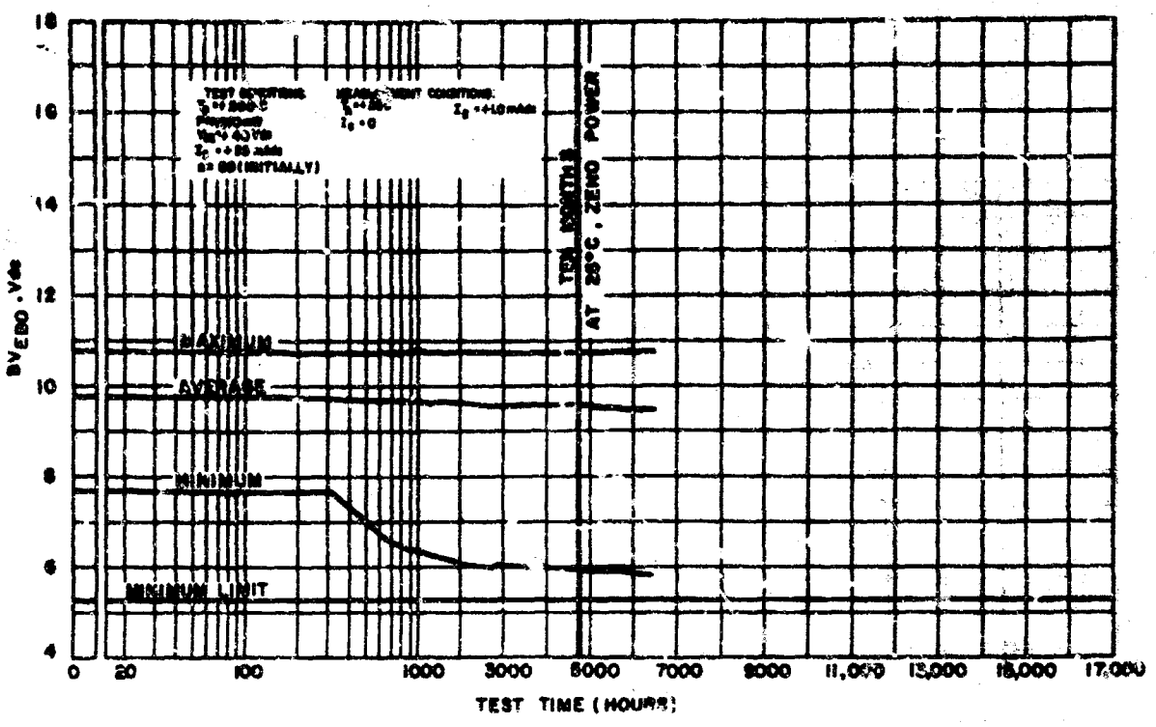
BVCBO VALUES IN VOLTS

28 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	119.464	8.757	103.000	139.100
24.	119.264	9.242	104.100	139.900
96.	120.111	9.37	104.100	141.300
196.	120.679	9.078	103.700	140.900
337.	120.593	9.184	104.400	140.700
504.	121.353	10.187	104.000	142.900
672.	121.875	10.257	104.000	142.900
840.	121.764	10.478	104.000	144.000
1008.	122.714	10.652	104.900	145.900
1344.	122.647	10.895	103.900	144.903
1512.	124.114	11.910	104.500	148.100
1680.	125.303	12.195	104.400	148.700
1849.	123.048	11.176	103.900	148.900	
2017.	123.119	11.386	104.300	149.300
2688.	123.382	11.497	103.900	148.900
2799.	123.679	11.254	103.900	150.900
3360.	123.767	11.781	103.910	153.100
3807.	124.440	11.447	104.1.0	153.300
4304.	124.311	11.098	104.700	154.400
4807.	122.757	12.732	103.900	155.300
4984.	124.740	13.819	101.100	155.900
5314.	125.201	11.953	104.000	156.300
5625.	124.879	12.271	104.000	156.900
6482.	125.000	11.811	103.900	157.100

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
21	504	1
	1680	1
	1849	1
	2017	1
	2688	1
	2849	1
	3360	1
	3360	1
	3807	1
	4304	1
	4984	1
	5625	1
	6482	1

Figure 3-62. Parameter Trend Chart, R2004P1, Phase IV, BV_{CBO}



PH 4 R2004P1 BVEBO

BVEBO VALUES IN VOLTS

TEST HOURS	26 PARTS AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	9.717	0.741	7.639	10.752
24.	9.736	0.748	7.639	10.771
96.	9.720	0.745	7.639	10.753
168.	9.714	0.749	7.639	10.7.9
337.	9.714	0.7?7	7.649	10.790
504.	9.687	0.684	7.671	10.730
672.	9.698	0.933	6.594	10.776
840.	9.694	0.952	6.434	10.774
1008.	9.671	0.943	6.359	10.744
1344.	9.635	0.973	6.299	10.71
1512.	9.649	0.682	6.224	10.733
1848.	9.691	0.987	6.176	10.779
1849.	9.69?	0.995	6.179	10.7??
2017.	9.617	1.027	6.264	10.718
2184.	9.593	1.099	5.999	10.711
2799.	9.584	1.107	6.021	10.709
3303.	9.578	1.129	6.002	10.718
3807	9.572	1.125	5.999	10.709
4304.	9.581	1.138	5.956	10.719
4827.	9.582	1.133	5.984	10.702
4994.	9.562	1.143	5.936	10.715
5424.	9.518	1.197	5.984	10.714
5721.	9.497	1.267	5.870	10.702
6482.	9.481	1.298	5.824	10.719

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
21	504	1
	1680	1
	1849	1
	2187	2
	2688	1
	2940	2
	3780	1
	3360	3
	3807	5
	4304	2
	4994	1
	5881	1
	6482	1

Figure 3-63. Parameter Trend Chart, R2004P1, Phase IV, BV_{EBO}

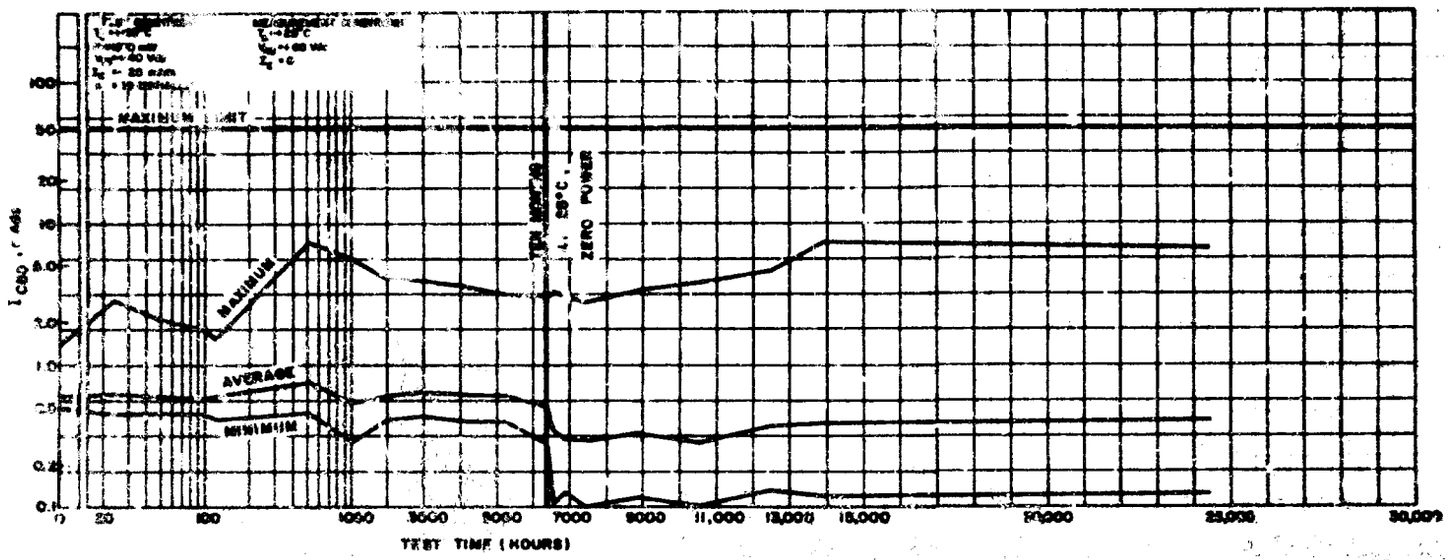
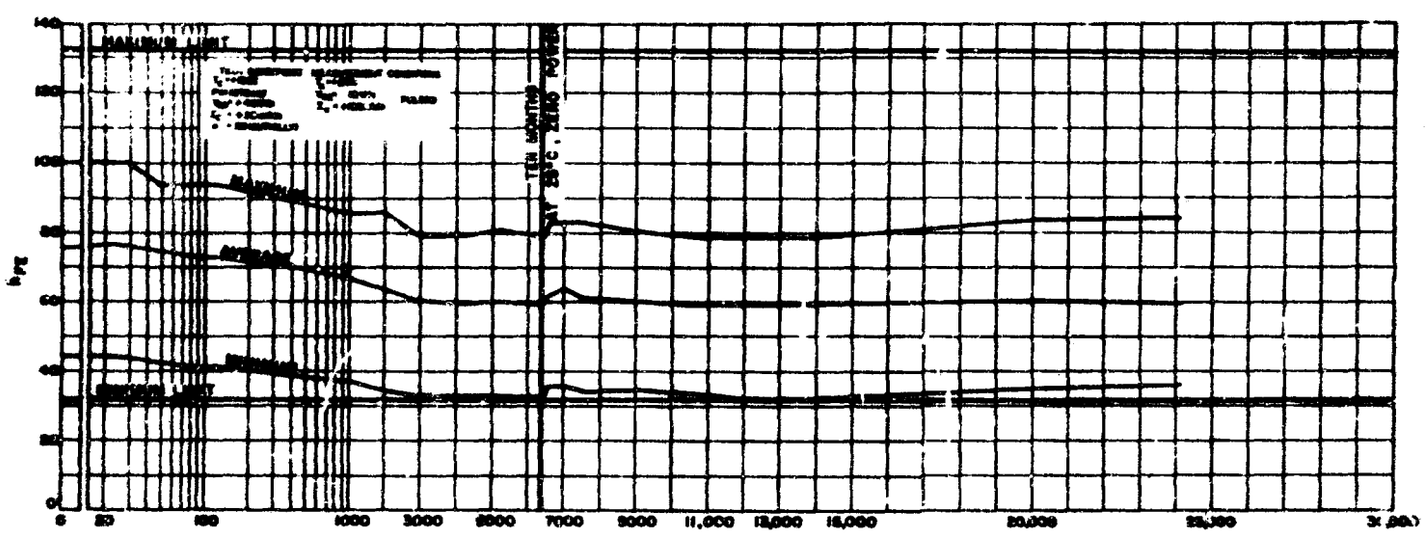


Figure 3-64. Parameter Trend Chart, R2004P1, Phase V, I_{CBO}



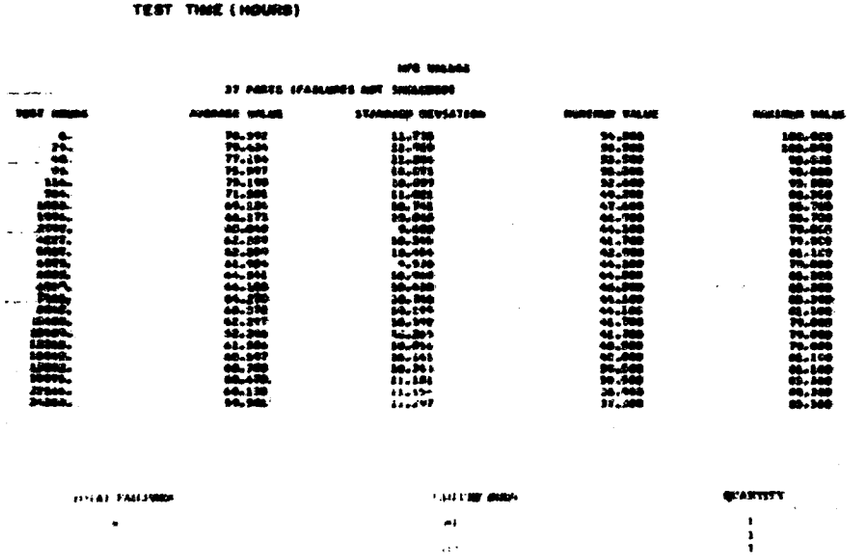
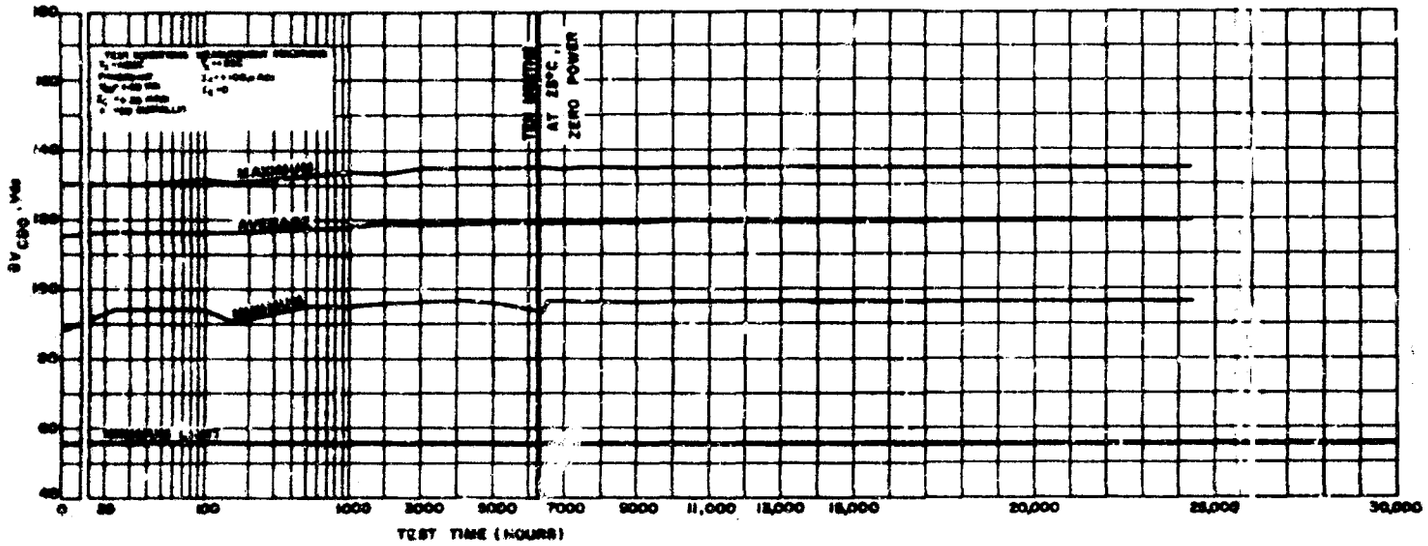


Figure 3-65. Parameter Trend Chart, R2004P1, Phase V, h_{FE}



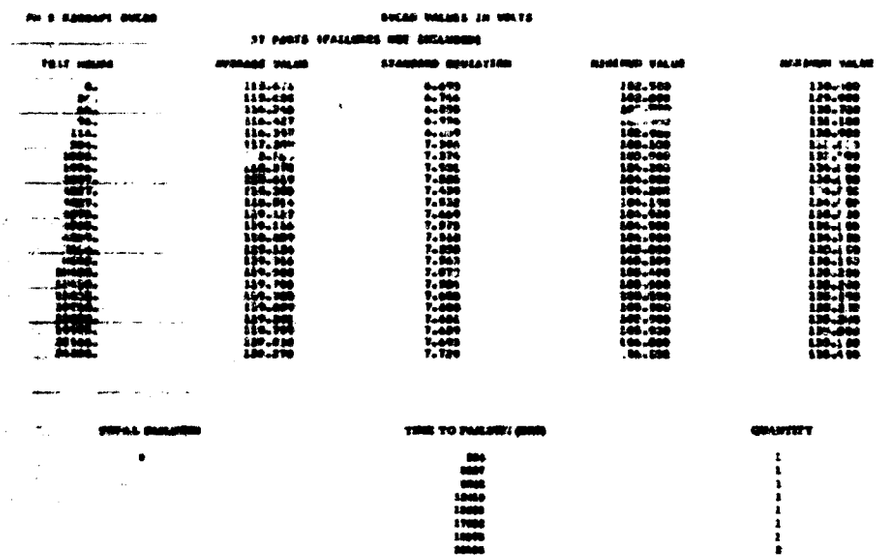
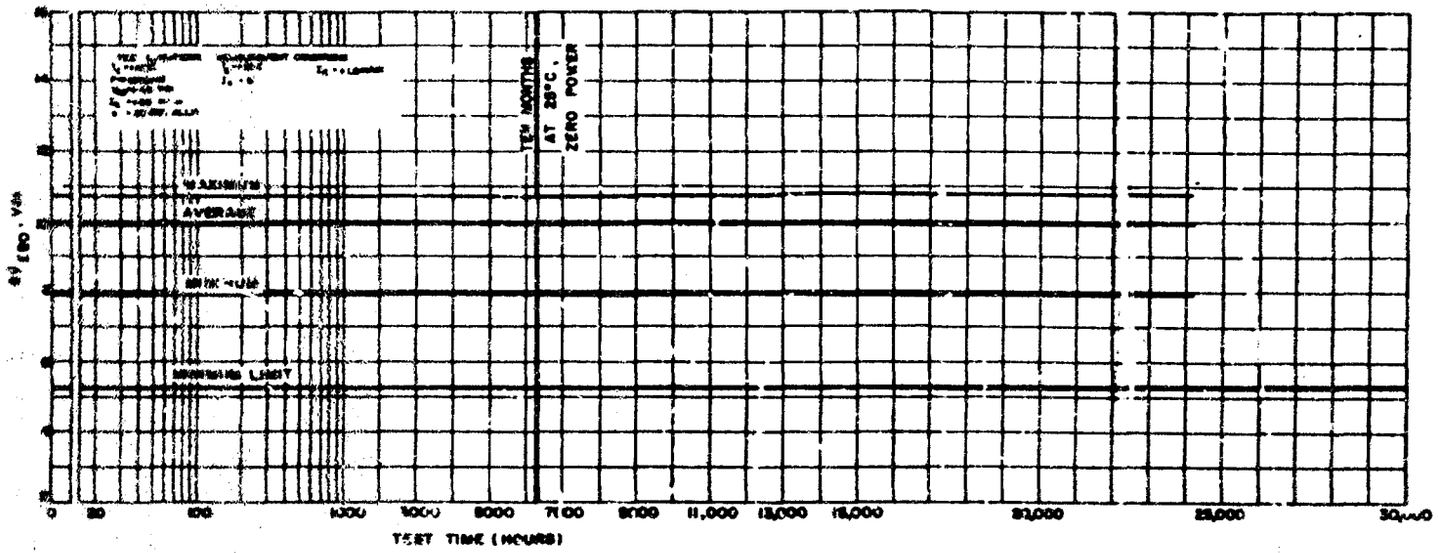


Figure 3-66. Parameter Trend Chart, R2004P1, Phase V, BV_{CBO}



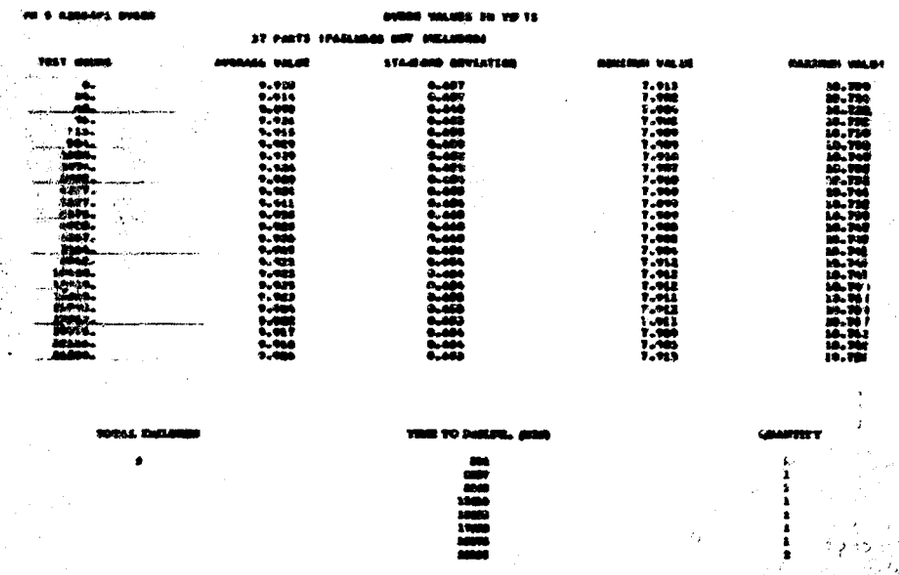
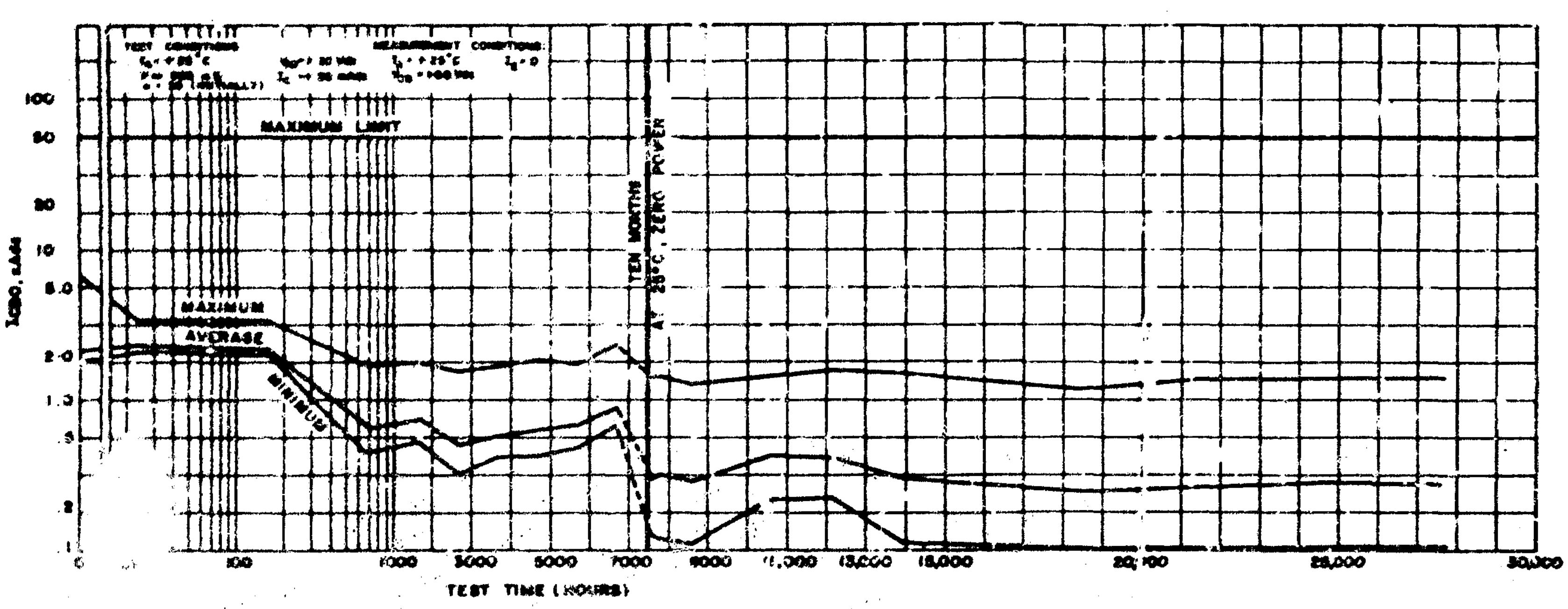


Figure 3-67. Parameter Trend Chart, R2004P1, Phase V, EV_{EB4}



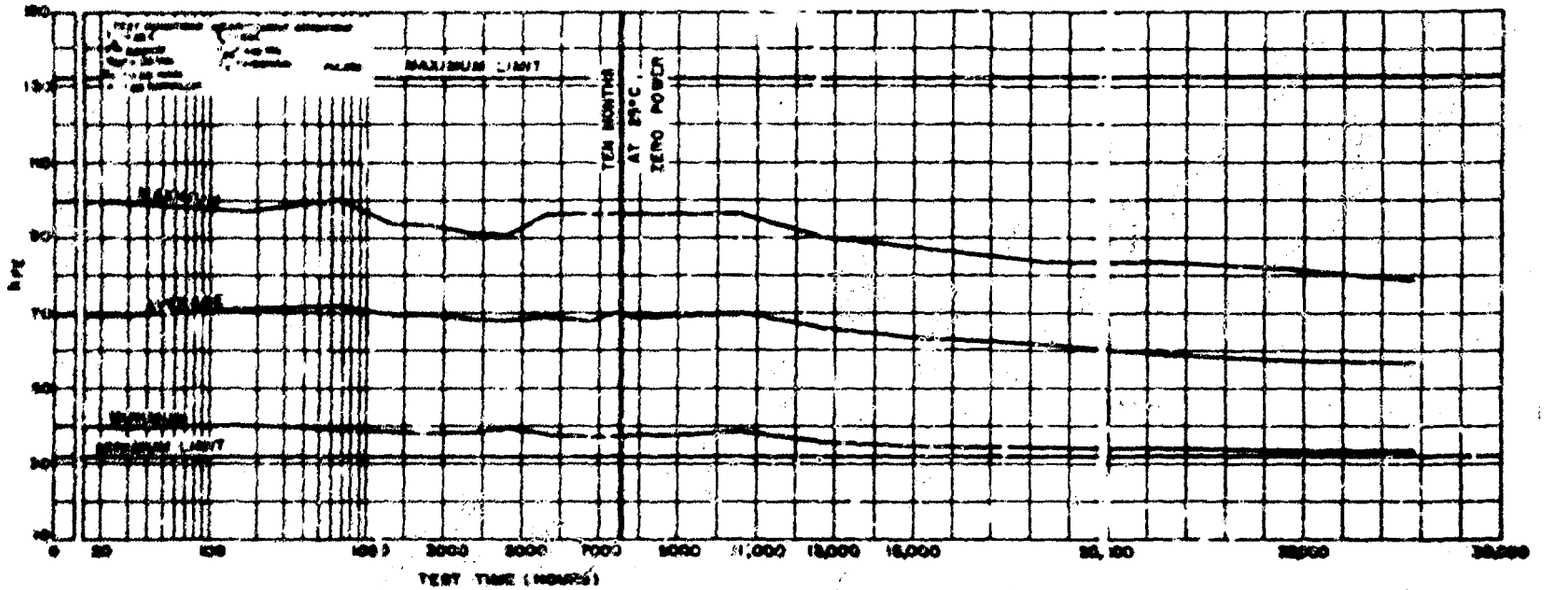
ICBO VALUES IN NANOAMPS

ALL PARTS (FAILURES NOT INCLUDED)

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	[illegible]	0.768	[illegible]	7.288
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUAN ITY
[illegible]	[illegible]	1

Figure 3-68. Parameter Trend Chart, R2004P1, Ambient Life, I_{CBO}



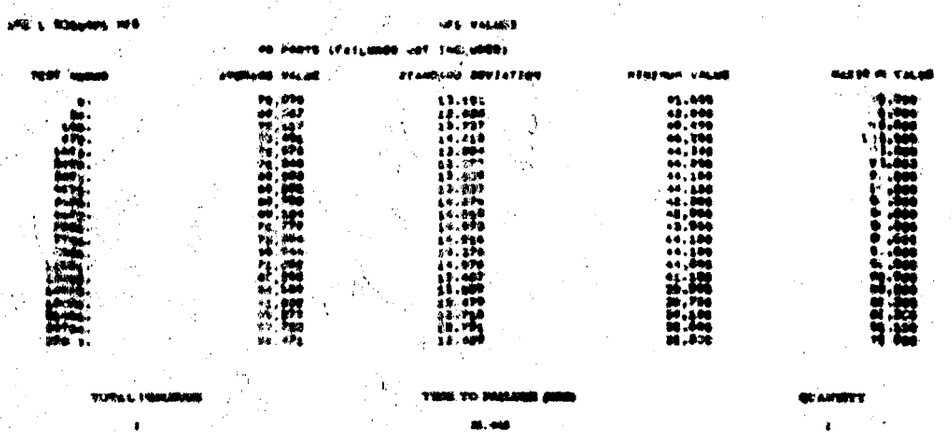
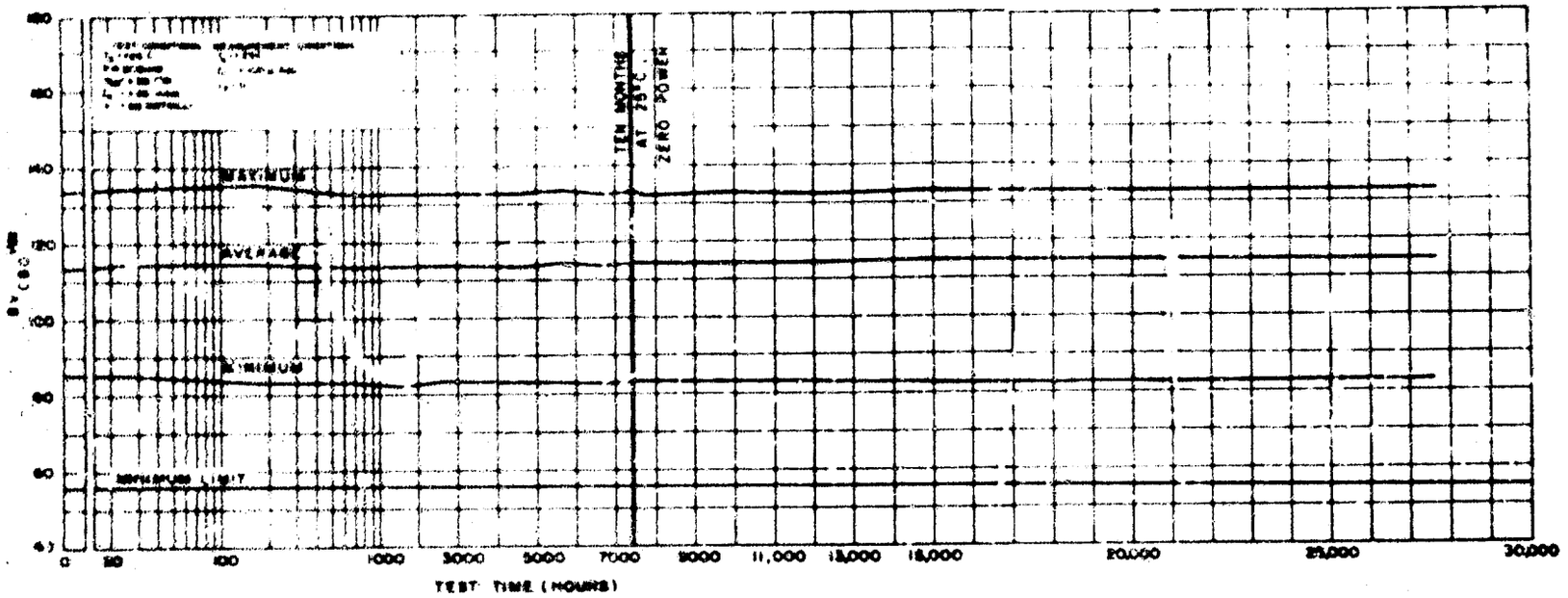


Figure 3-69. Parameter Trend Chart, R2004P1, Ambient Life, h_{FE}



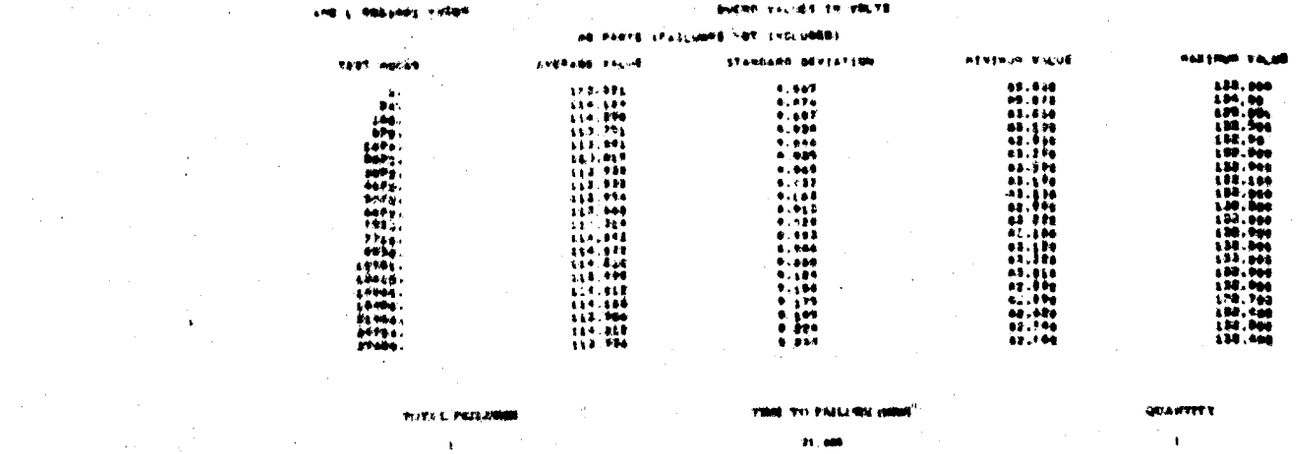
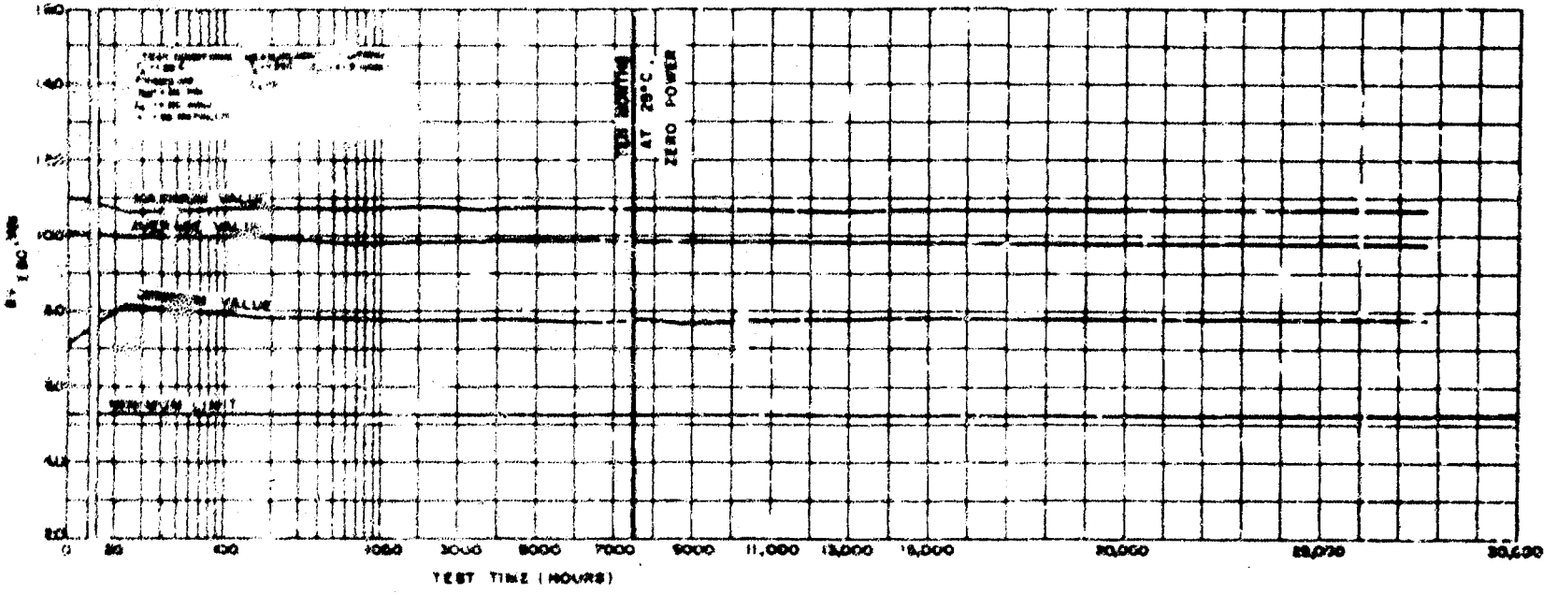


Figure 3-70. Parameter Trend Chart, R2004P1, Ambient Life, BV_{CBO}



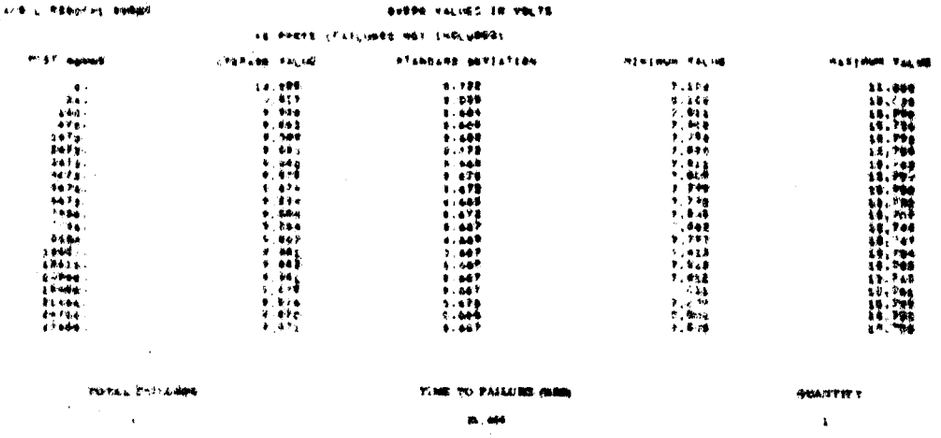


Figure 3-71. Parameter Trend Chart, R2004P1, Ambient Life, BV_{EBO}

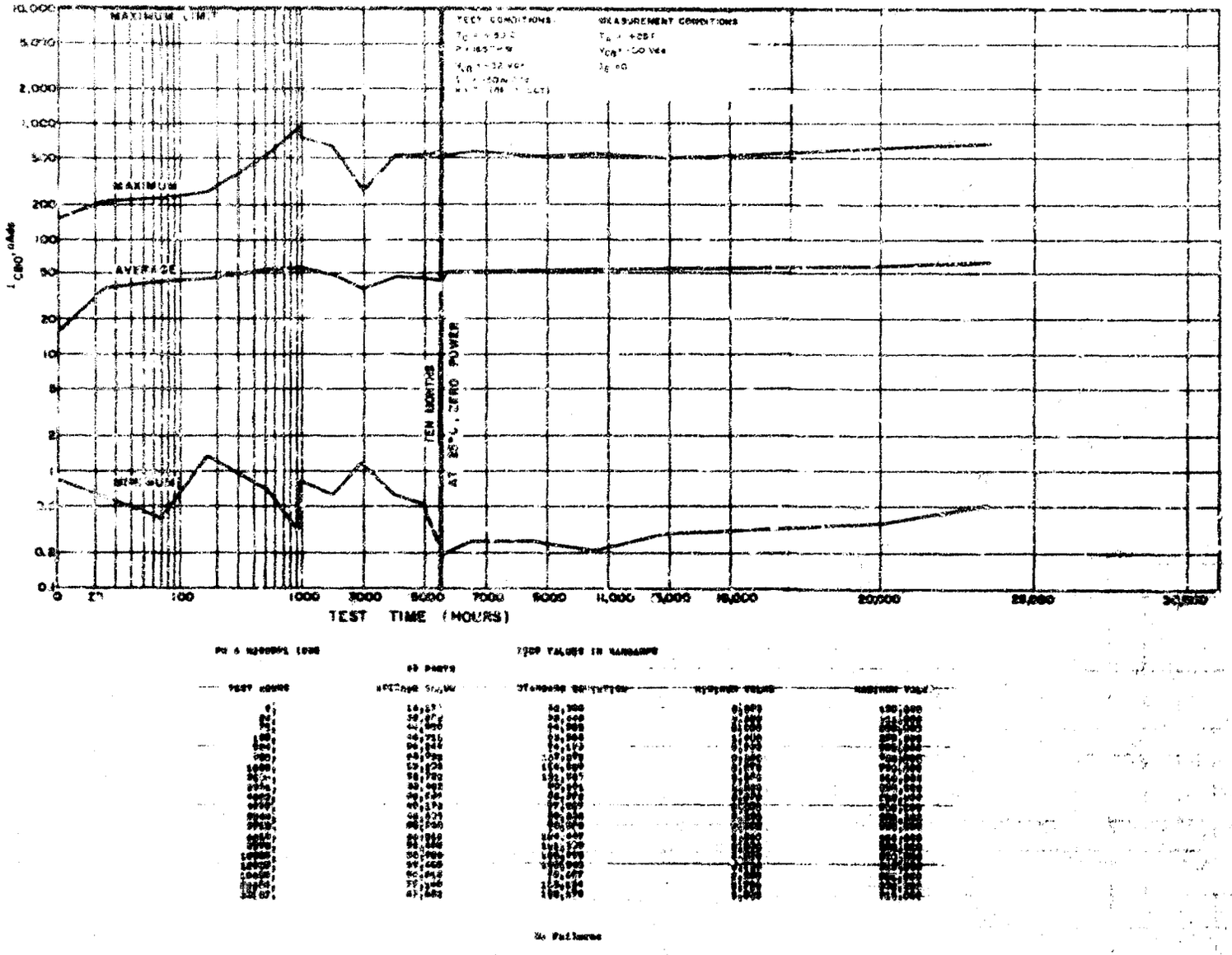
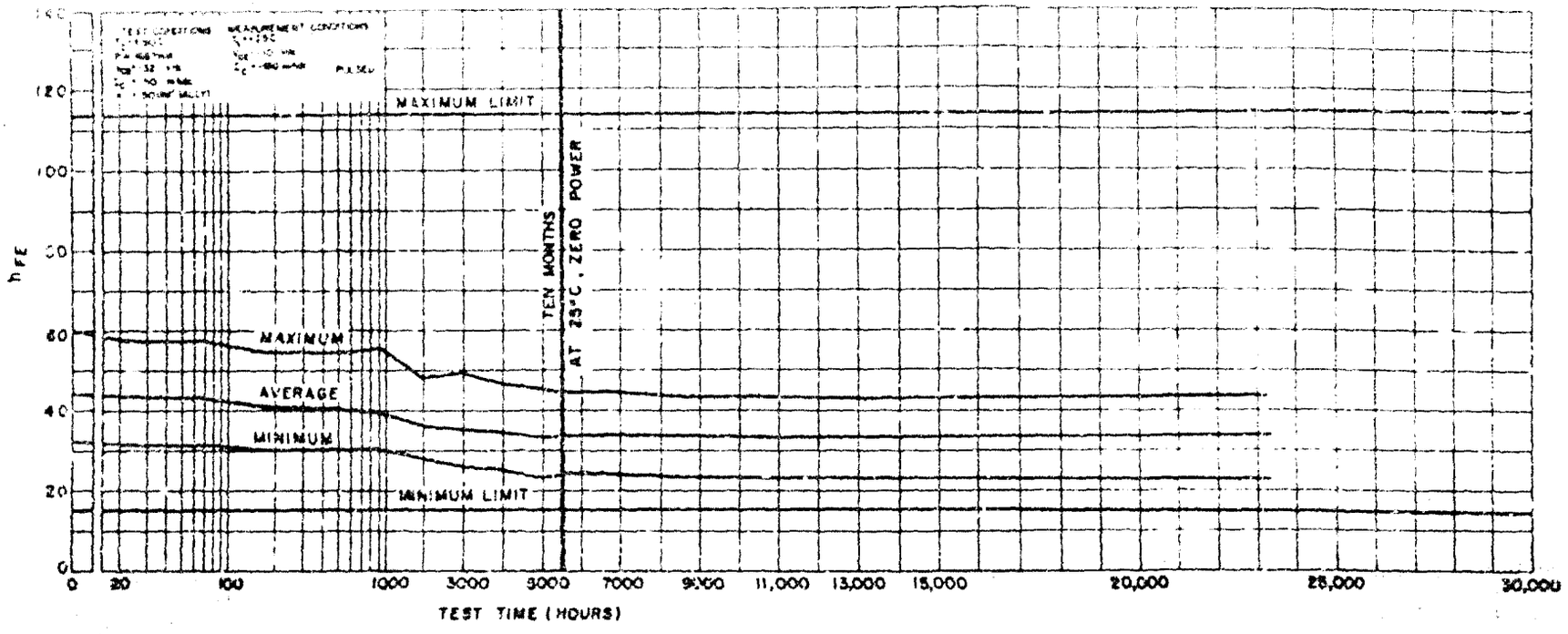


Figure 3-72. Parameter Trend Chart, R2005F1, Phase VI, I_{CBO}



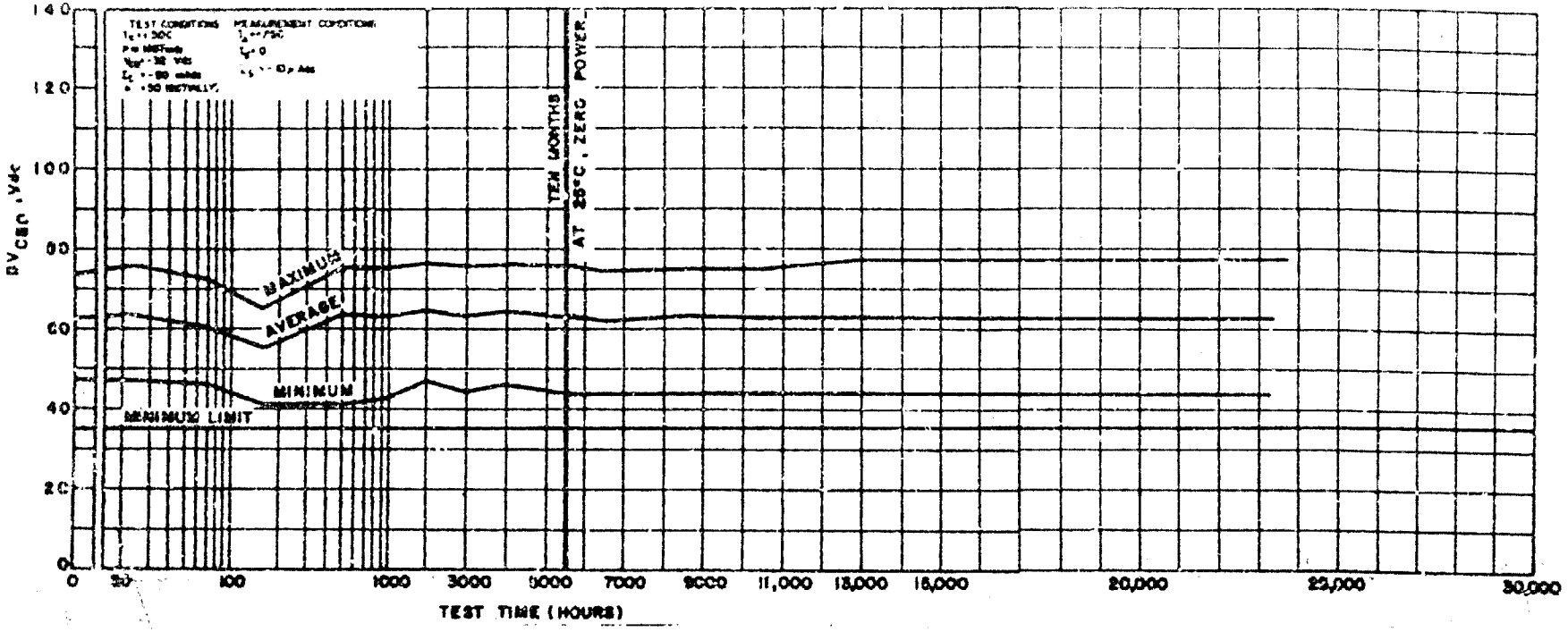
hFE VALUES

48 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	44,088	6,329	32,500	66,000
24	46,695	6,161	31,960	57,000
72	43,159	6,278	31,200	57,300
168	41,208	5,527	30,650	54,600
264	41,112	5,569	30,000	54,600
528	39,431	5,981	30,000	55,000
1008	39,921	5,775	30,000	54,300
2016	39,247	5,232	27,000	48,400
3001	39,418	5,263	29,000	49,200
4056	34,837	4,843	28,400	46,900
4872	34,780	4,736	29,000	45,900
5360	33,816	4,690	26,000	44,100
5712	33,705	4,671	26,000	44,100
6816	34,171	4,917	25,200	44,000
8952	33,714	4,865	25,400	43,900
10080	33,971	4,793	25,100	43,500
12058	33,322	4,791	25,100	42,900
18456	33,633	4,828	25,900	42,500
22896	32,329	4,884	25,100	44,900
23317	32,292	4,736	25,400	41,200

No Failures

Figure 3-73. Parameter Trend Chart, R2005P1, Phase VI, h_{FE}



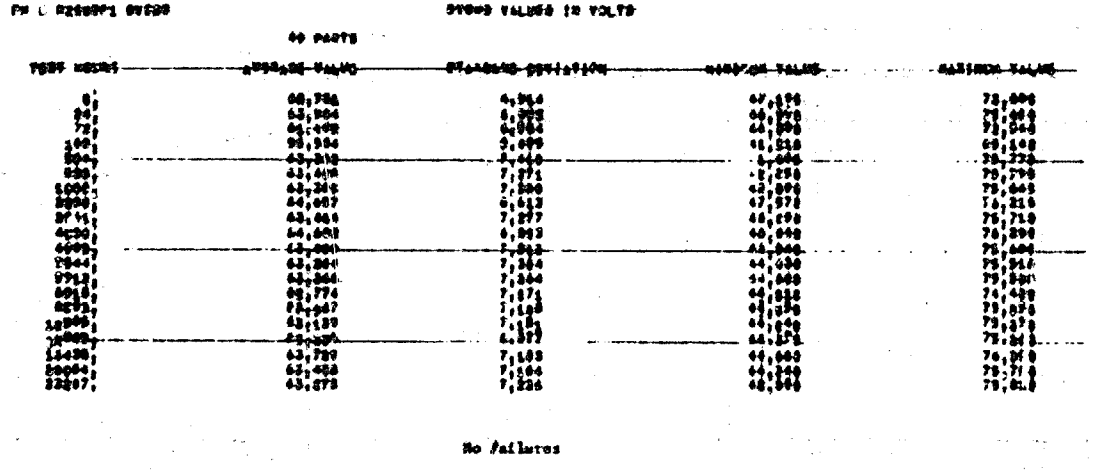


Figure 3-74. Parameter Trend Chart, R2005P1, Phase VI, BV_{CBO}

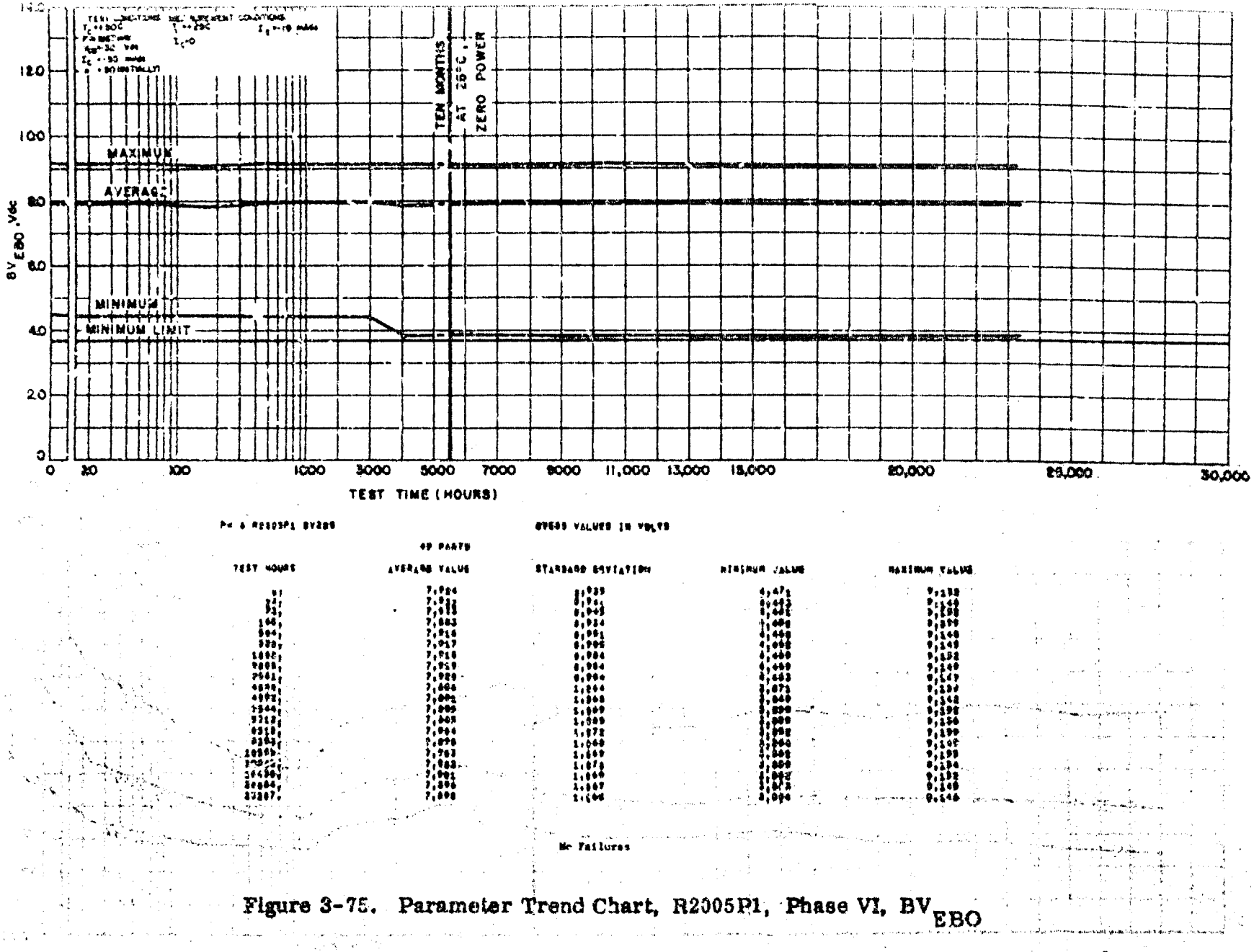
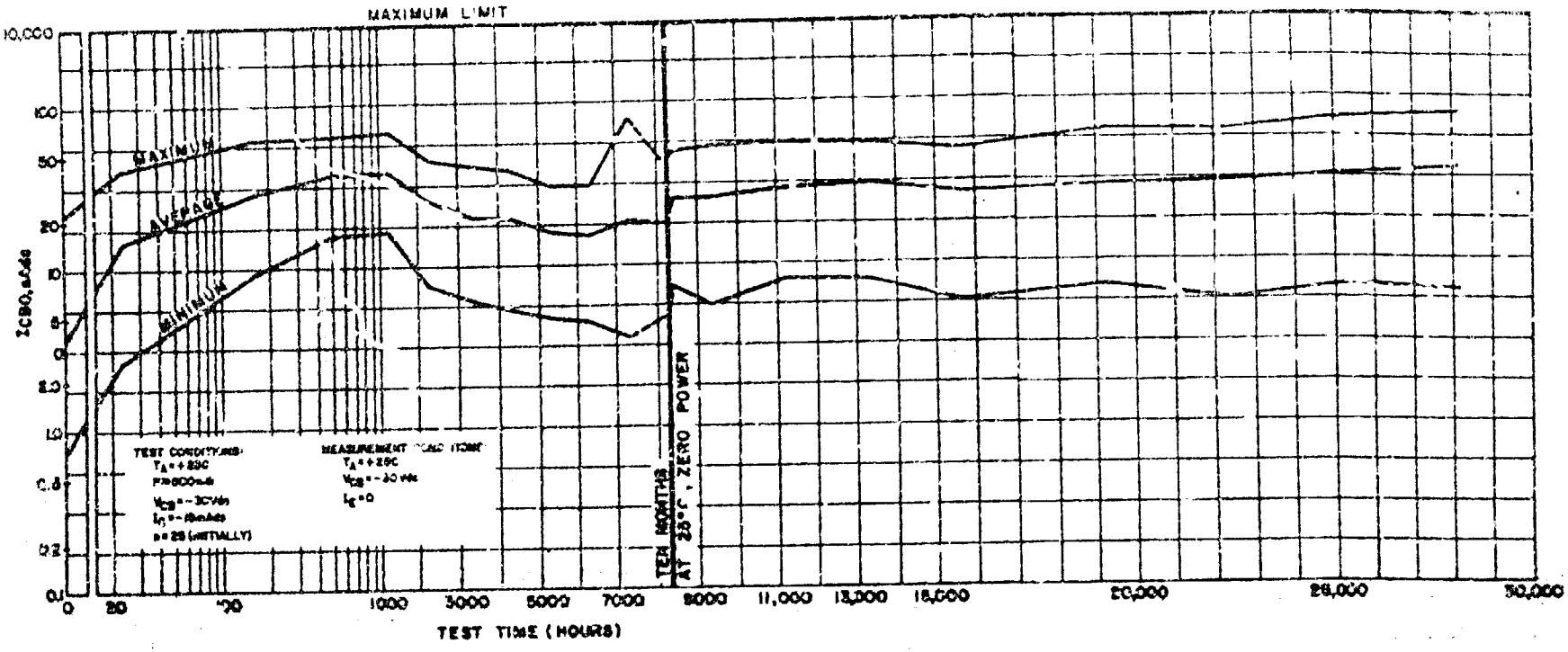
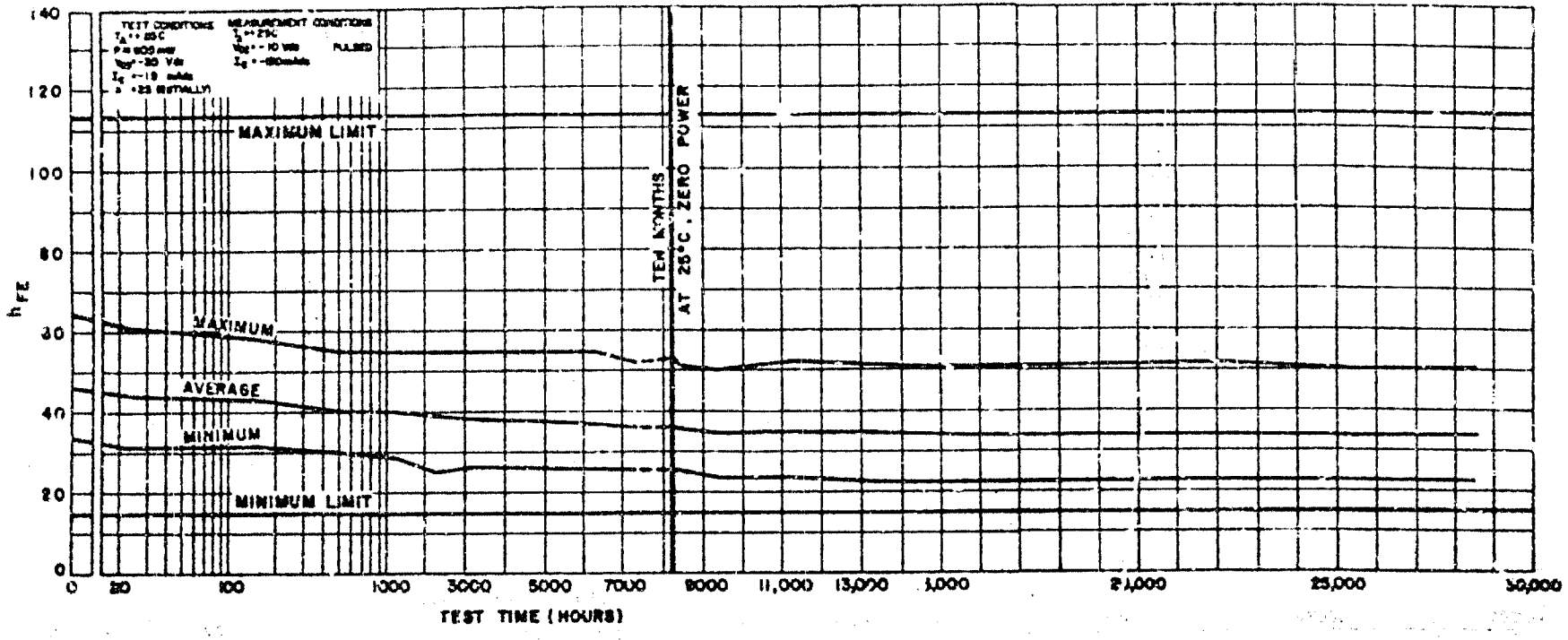


Figure 3-75. Parameter Trend Chart, R2005P1, Phase VI, BV_{EBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	3,977	9,262	0.725	31.500
24	15,744	17.679	2.750	44.000
168	38,750	13.062	9.400	62.000
504	59,042	12.264	16.500	66.000
1344	49,937	12.488	17.500	68.445
2344	29,779	14.329	7.750	45.000
3344	21,279	9.764	6.388	42.000
4344	28,937	9.198	9.500	39.000
5344	16,146	7.496	4.750	32.000
6344	15,925	7.471	6.500	32.250
7344	19,656	19.088	3.705	98.000
8344	18,976	8.969	5.000	48.000
9479	27,312	14.450	7.000	95.000
9896	26,799	11.837	5.000	54.000
11287	38,695	12.293	6.200	97.000
12341	32,153	11.471	8.000	90.000
13731	29,950	11.996	6.000	58.000
14784	38,125	12.468	7.000	60.000
22332	31,884	13.919	9.750	61.000
25278	32,654	15.438	6.000	78.500
26496	34,546	18.498	8.283	78.000

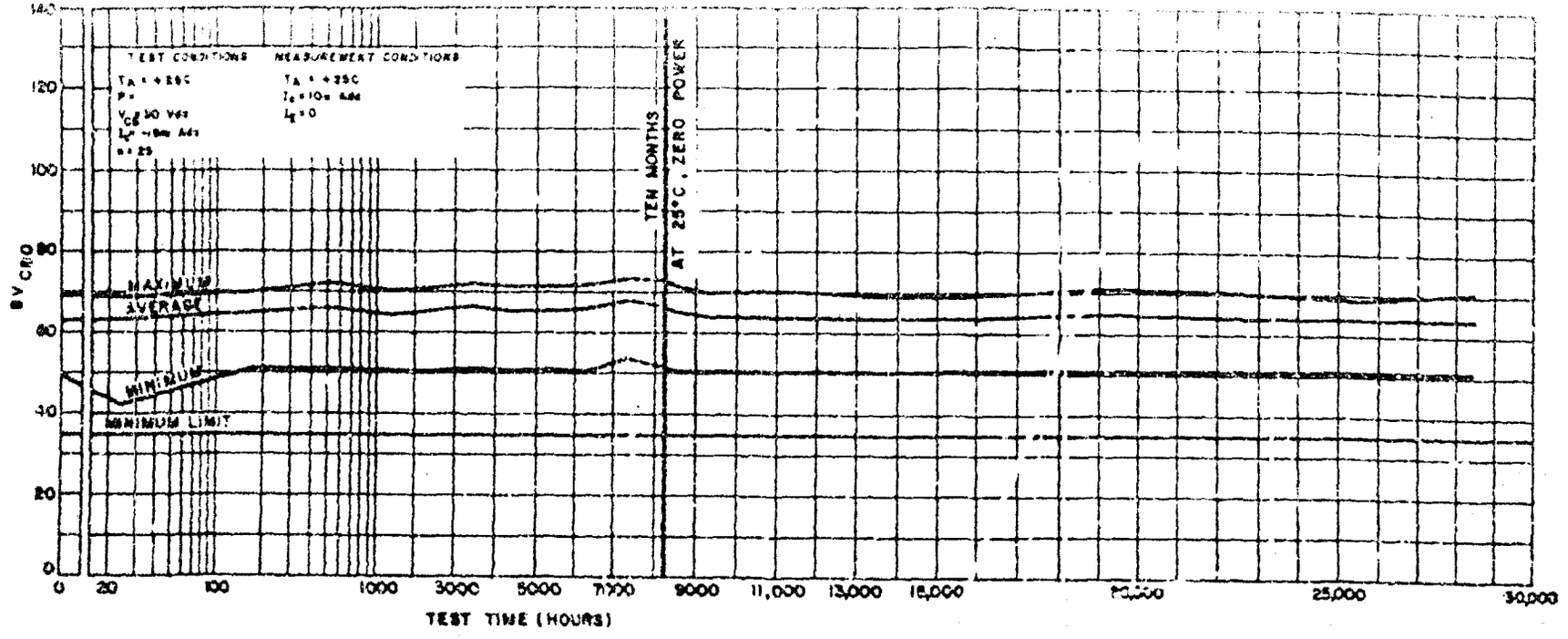
Figure 3-76. Parameter Trend Chart, B2005P1, Ambient Life, I_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	43.964	8.587	34.100	69.288
24.	44.780	8.411	31.600	61.250
168.	43.869	7.869	31.500	58.000
504.	43.581	7.831	30.000	55.000
1344.	43.377	7.496	28.000	59.000
2184.	39.898	8.897	25.500	59.000
3024.	38.929	7.906	26.900	53.600
4344.	38.610	7.599	26.350	99.950
5344.	37.642	7.973	26.100	55.500
6344.	37.358	7.576	25.900	59.500
7344.	36.697	8.068	25.900	92.600
8304.	36.756	7.965	23.900	53.600
8472.	36.852	7.836	25.300	51.700
9504.	35.958	7.189	24.200	50.000
11207.	35.758	7.438	24.200	52.600
13301.	35.842	7.394	23.400	51.700
15731.	34.958	7.376	23.350	51.700
19224.	34.867	7.414	22.700	51.700
22233.	34.371	7.473	22.200	51.700
25477.	33.584	7.346	21.400	50.000
29454.	33.541	7.405	21.400	50.000

No Failures

Figure 3-77. Parameter Trend Chart, R2005P1, Ambient Life, h_{FE}



AMP 2 R2005P1 BVCBO

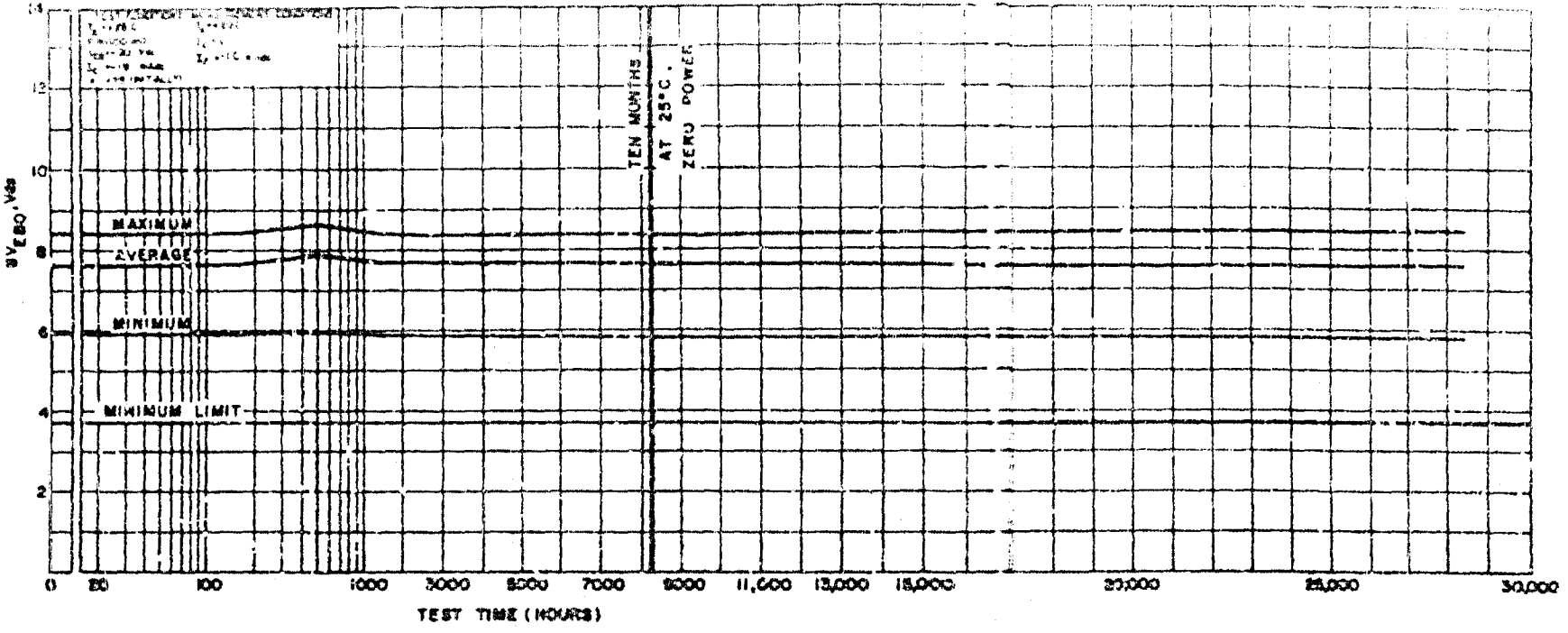
BVCBO VALUES IN VOLTS

24 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	63.814	4.368	49.648	69.798
24.	63.878	5.048	49.847	69.388
168.	64.095	5.136	51.098	70.098
504.	66.358	5.394	51.868	72.648
1344.	66.517	5.351	50.928	70.638
3144.	65.809	5.227	51.188	71.298
4848.	66.047	5.314	51.798	72.018
4944.	65.879	5.315	51.116	71.748
5544.	65.956	5.33	51.048	71.708
6744.	66.076	5.436	51.198	72.598
7344.	66.389	5.428	50.148	73.998
8064.	66.042	5.383	51.738	73.048
8472.	65.922	5.215	51.348	71.898
9384.	66.717	5.287	51.898	73.498
11264.	66.548	5.272	51.128	73.378
13344.	66.368	5.237	51.848	73.998
15736.	66.184	5.233	51.028	73.698
18236.	65.873	5.148	51.128	73.138
22232.	66.596	5.253	51.878	73.438
25672.	66.218	5.238	50.438	73.798
29499.	66.527	5.289	51.848	73.378

No Failures

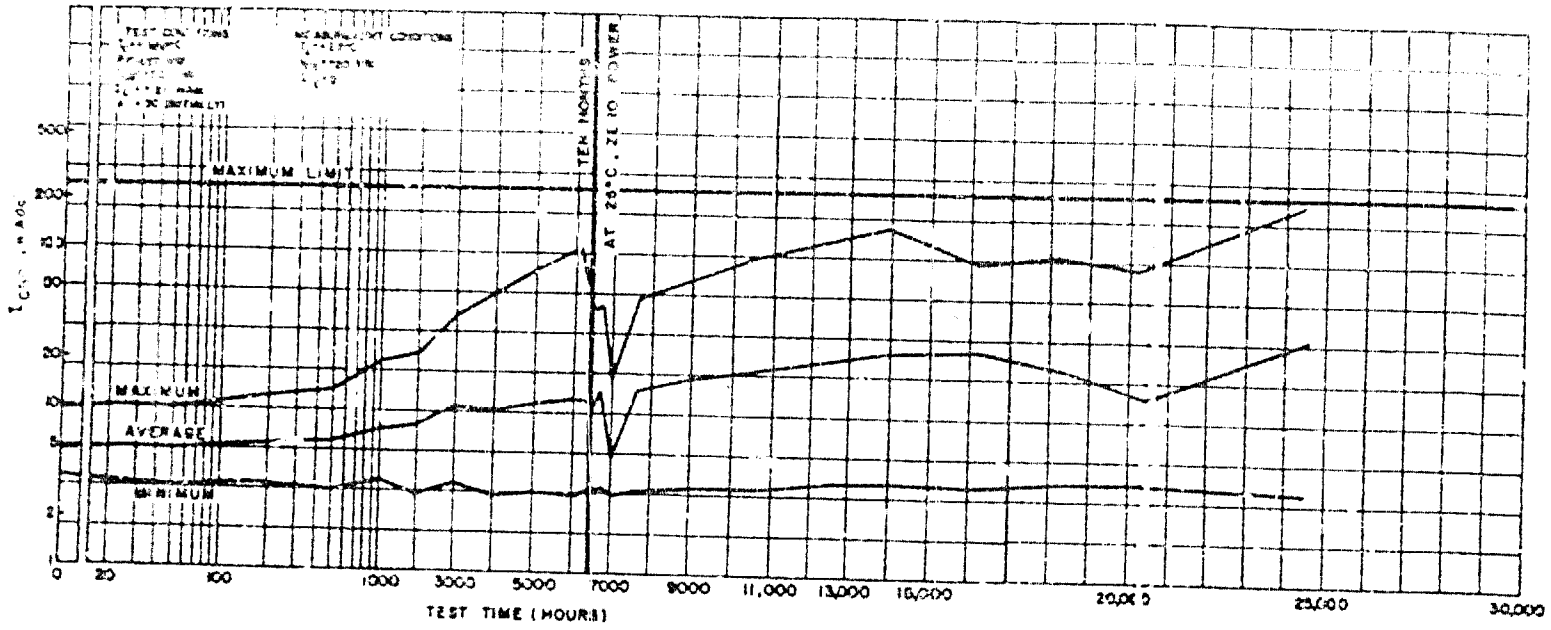
Figure 3-78. Parameter Trend Chart, R2005P1, Ambient Life, BV_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	7.648	0.526	5.[illegible]	8.913
24	7.555	0.538	5.[illegible]	8.194
144	7.646	0.529	5.[illegible]	8.395
344	7.673	0.598	5.[illegible]	8.868
1344	7.679	0.531	5.[illegible]	8.499
2344	7.642	0.529	5.[illegible]	8.382
3344	7.647	0.529	5.[illegible]	8.389
4344	7.656	0.528	5.[illegible]	8.386
5344	7.656	0.526	5.[illegible]	8.387
6344	7.653	0.527	5.[illegible]	8.391
7344	7.643	0.526	5.[illegible]	8.373
8861	7.611	0.517	5.[illegible]	8.346
9879	7.656	0.529	5.[illegible]	8.390
9884	7.649	0.528	5.[illegible]	8.359
11297	7.642	0.529	5.[illegible]	8.401
13881	7.646	0.528	5.[illegible]	8.404
15731	7.642	0.529	5.[illegible]	8.431
19224	7.644	0.530	5.[illegible]	8.462
22329	7.650	0.529	5.[illegible]	8.395
25479	7.645	0.528	5.[illegible]	8.392
28454	7.641	0.529	5.[illegible]	8.394

No Failures

Figure 3-79. Parameter Trend Chart, R2005P1, Ambient Life, BV_{EBO}



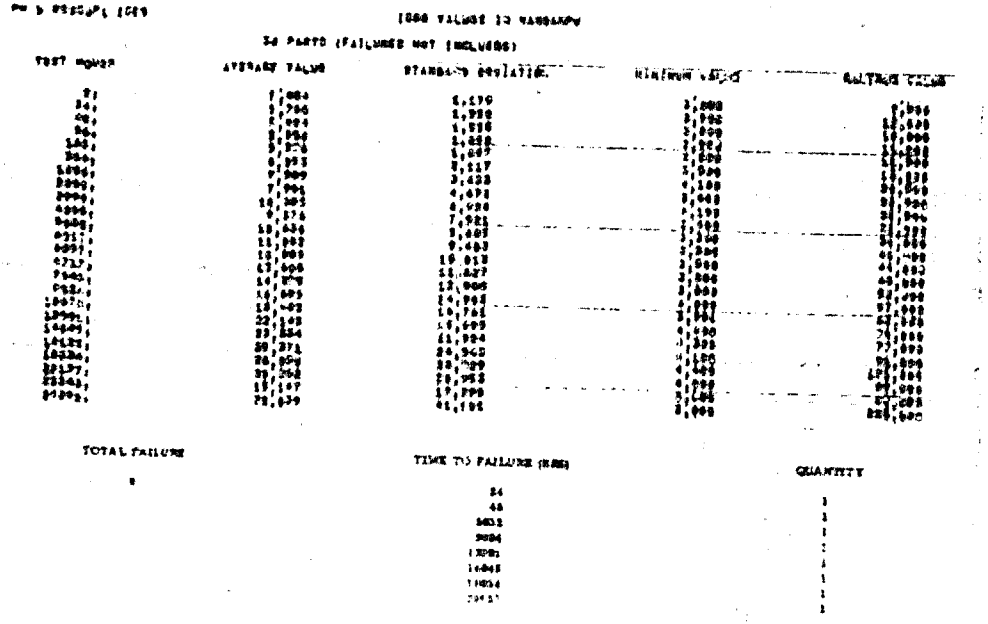
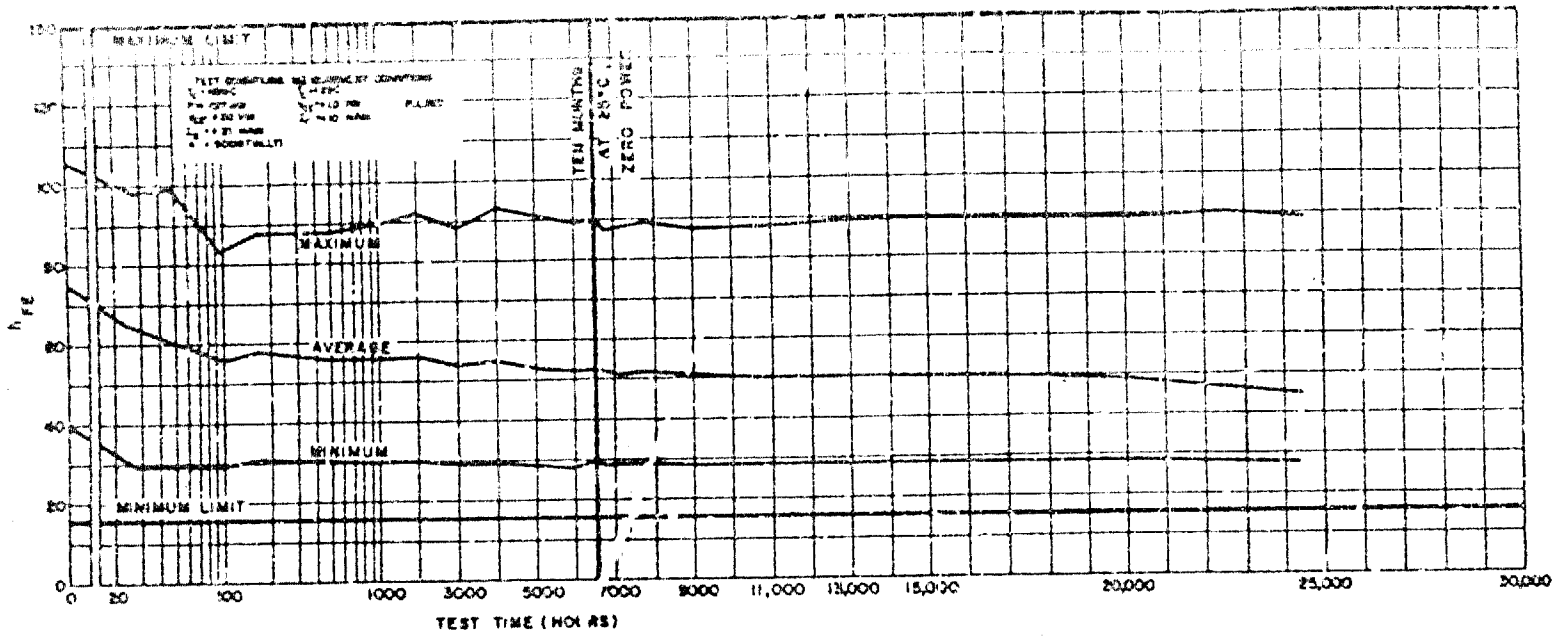


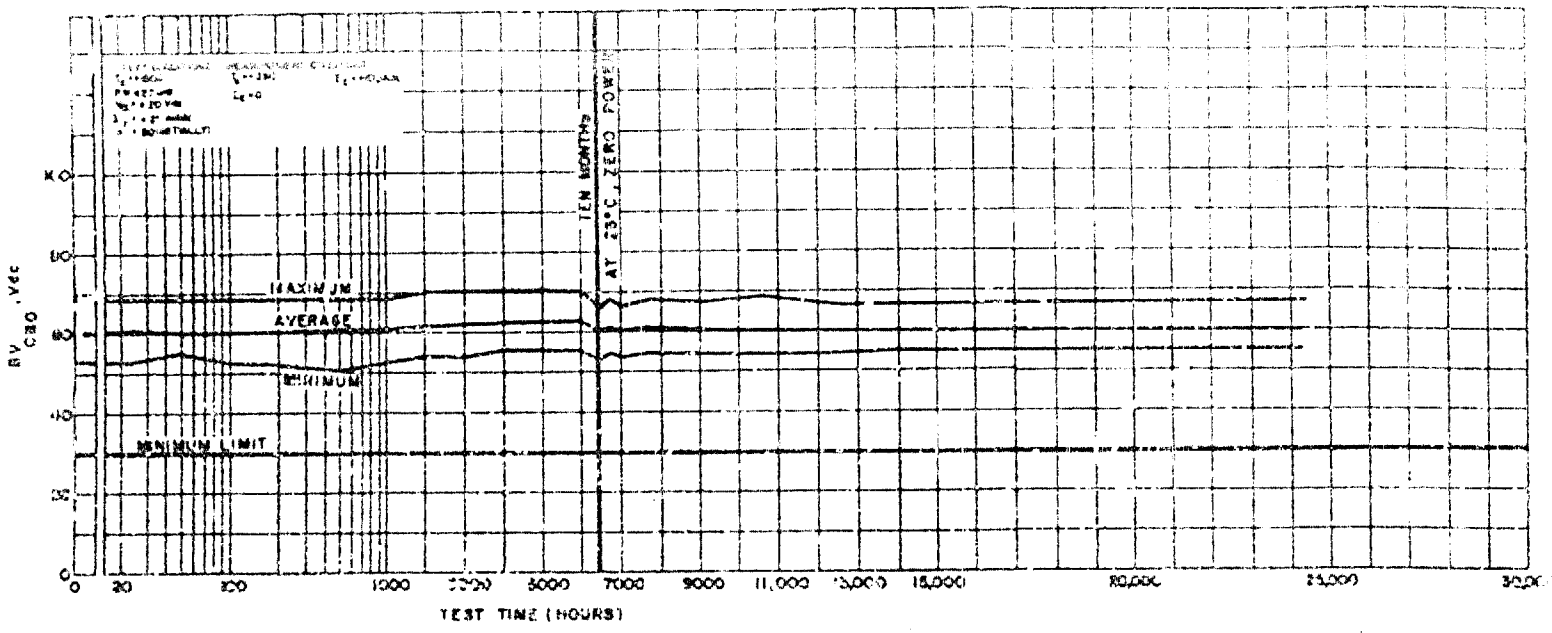
Figure 3-80. Parameter Trend Chart, R2023Pi, Phase V, I_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	77.234	17.694	39.909	105.809
24.	69.671	13.647	36.286	96.286
48.	62.766	14.090	28.184	90.606
96.	57.939	14.319	33.098	87.444
168.	59.648	15.282	35.658	87.883
264.	57.114	13.346	32.988	87.988
1008.	56.991	14.157	33.258	88.588
3000.	56.413	14.084	32.593	87.588
5000.	54.532	14.987	33.600	87.888
6972.	55.526	17.539	31.198	90.536
9036.	53.187	14.413	30.588	83.288
11016.	51.903	14.216	29.606	86.256
13001.	53.832	14.473	32.198	89.588
15017.	52.421	14.295	32.708	87.588
19008.	52.178	14.257	30.888	87.798
20448.	52.418	14.353	32.448	88.548
22994.	53.855	14.849	32.184	87.948
25578.	54.983	15.977	31.388	87.5?8
29481.	54.921	15.972	31.588	87.788
32944.	54.668	15.759	31.388	89.348
36332.	49.298	15.264	31.898	88.548
38836.	49.197	15.348	30.698	89.388
39137.	48.818	13.733	28.788	87.958
23246.	44.905	12.891	28.288	84.188
24930.	45.963	12.475	31.988	90.588

TOTAL FAILURE	TIME TO FAILURE (HOUR)	QUANTITY
0	0.	1
	0.	1
	5008	1
	6994	1
	12965	1
	16045	1
	18994	1
	36 17	1

Figure 3-81. Parameter Trend Chart, R2028P1, Phase V, h_{FE}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	66.736	2.678	57.140	66.950
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48.	66.961	2.716	58.776	66.498
96.	[illegible]	[illegible]	[illegible]	[illegible]
168.	66.973	2.146	53.746	66.708
336.	66.937	3.192	38.816	66.830
1008.	67.073	3.012	52.600	66.944
2000.	67.156	3.206	54.000	66.356
3000.	67.129	3.239	54.816	66.366
4003.	67.277	3.121	55.916	66.644
5032.	67.525	2.96[illegible]	55.600	67.867
6013.	67.667	2.901	58.698	67.244
6697.	66.326	2.711	54.210	66.198
6717.	67.010	2.720	54.000	66.720
7016.	66.894	2.705	55.050	66.320
7363.	67.024	2.701	54.099	66.735
8346.	66.972	2.722	54.000	66.000
10[illegible]	66.882	2.796	54.540	67.006
12681.	66.777	2.626	59.013	67.000
13069.	63.796	1.579	59.018	66.198
16122.	64.787	2.561	52.062	66.130
18034.	66.856	2.009	26.100	66.696
20157.	66.963	2.669	56.720	66.198
22248.	66.116	2.641	56.598	65.916
24798.	66.753	1.969	35.050	66.126

TOTAL FAILURE	TIME TO FAILURE (HRS)	QUANTITY
8	24	1
	48	1
	3852	1
	9894	1
	13681	1
	12345	1
	19484	1
	19567	1

Figure 3-82. Parameter Trend Chart, R2026P1, Phase V, BV_{CBO}

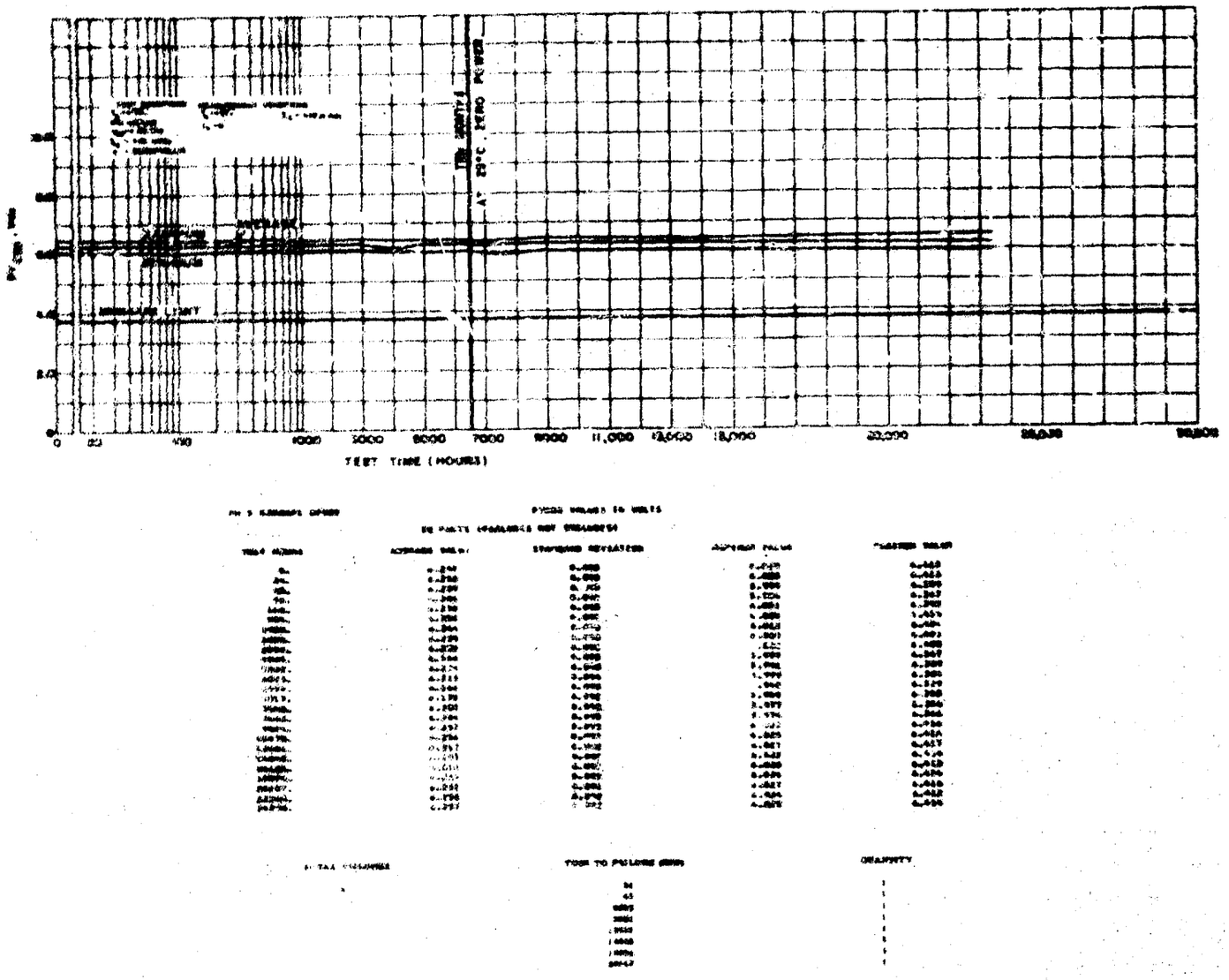
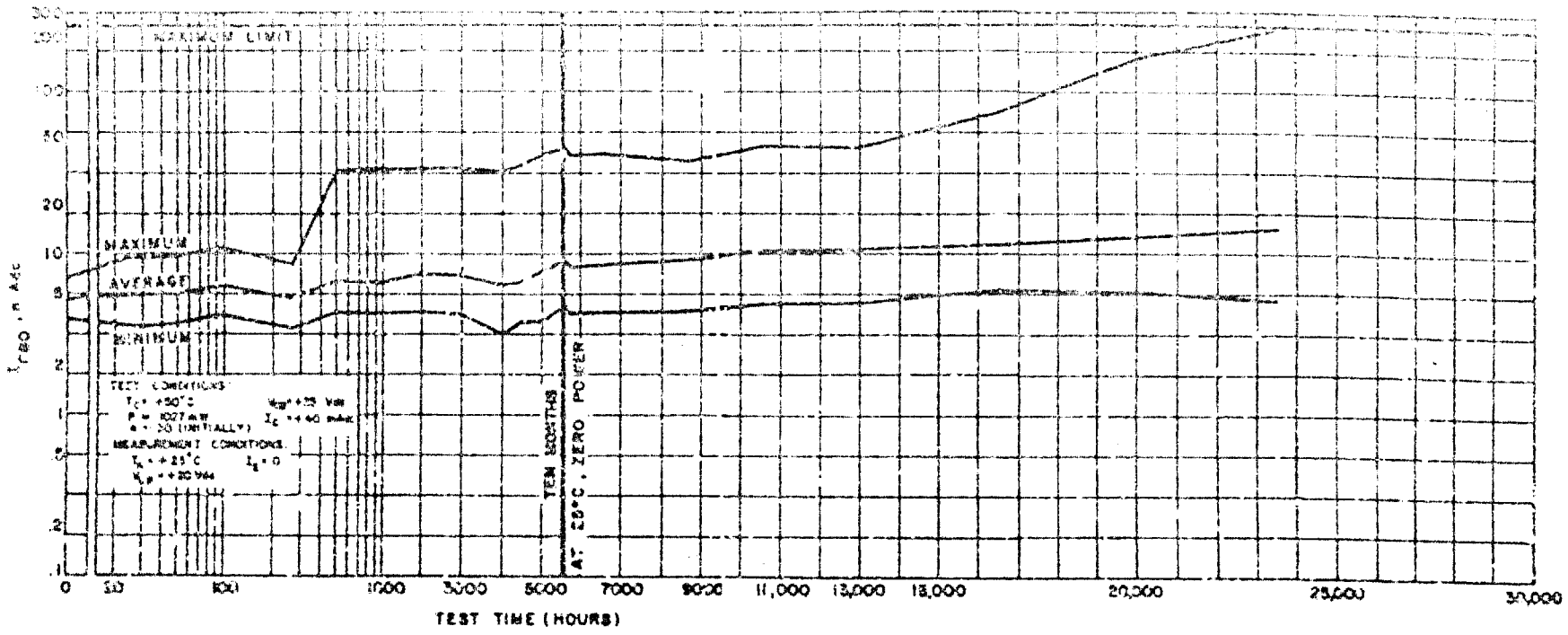


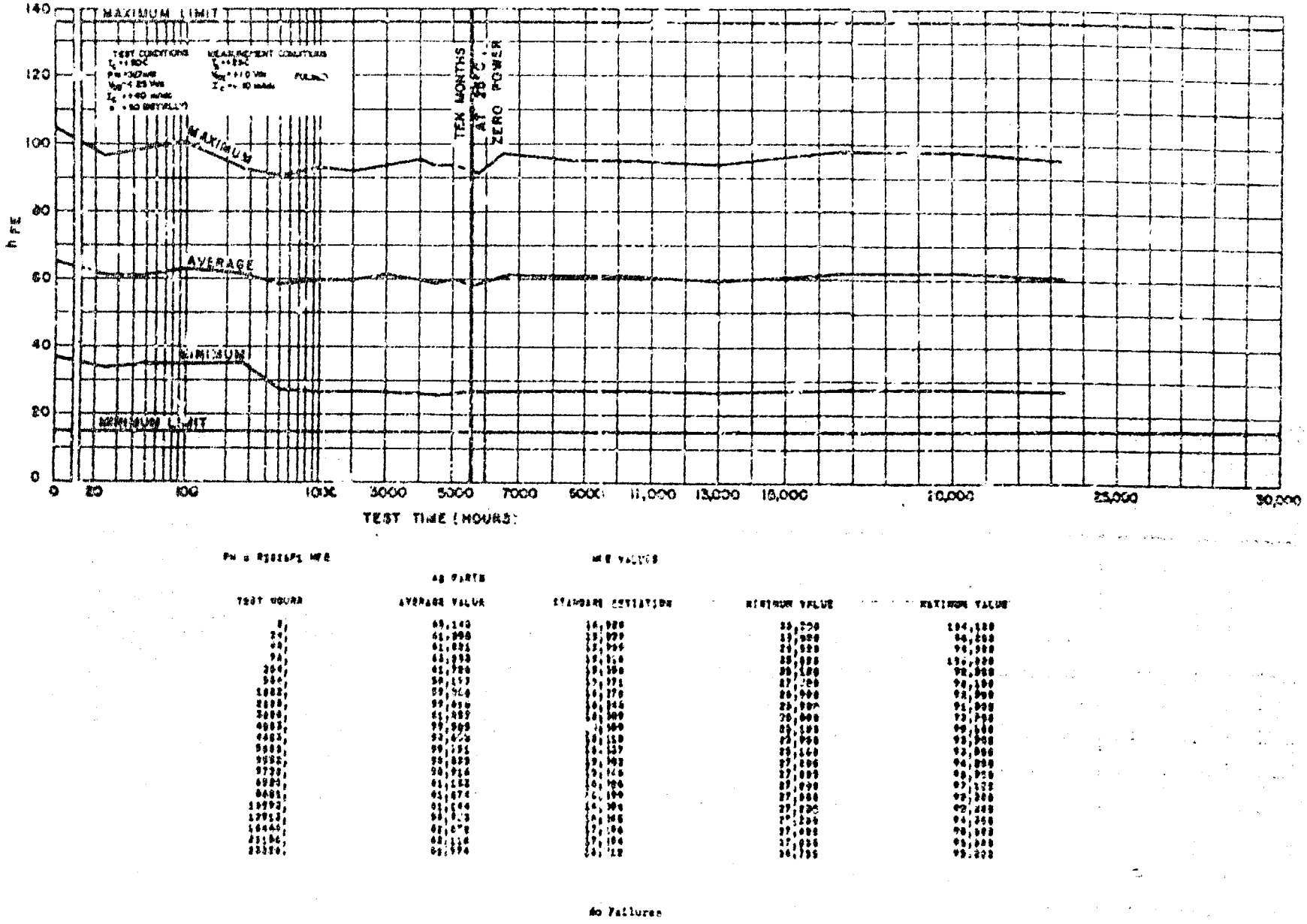
Figure 3-83. Parameter Trend Chart, R2036P1, Phase V, BV_{EBO}



43 PARTS

No Failures

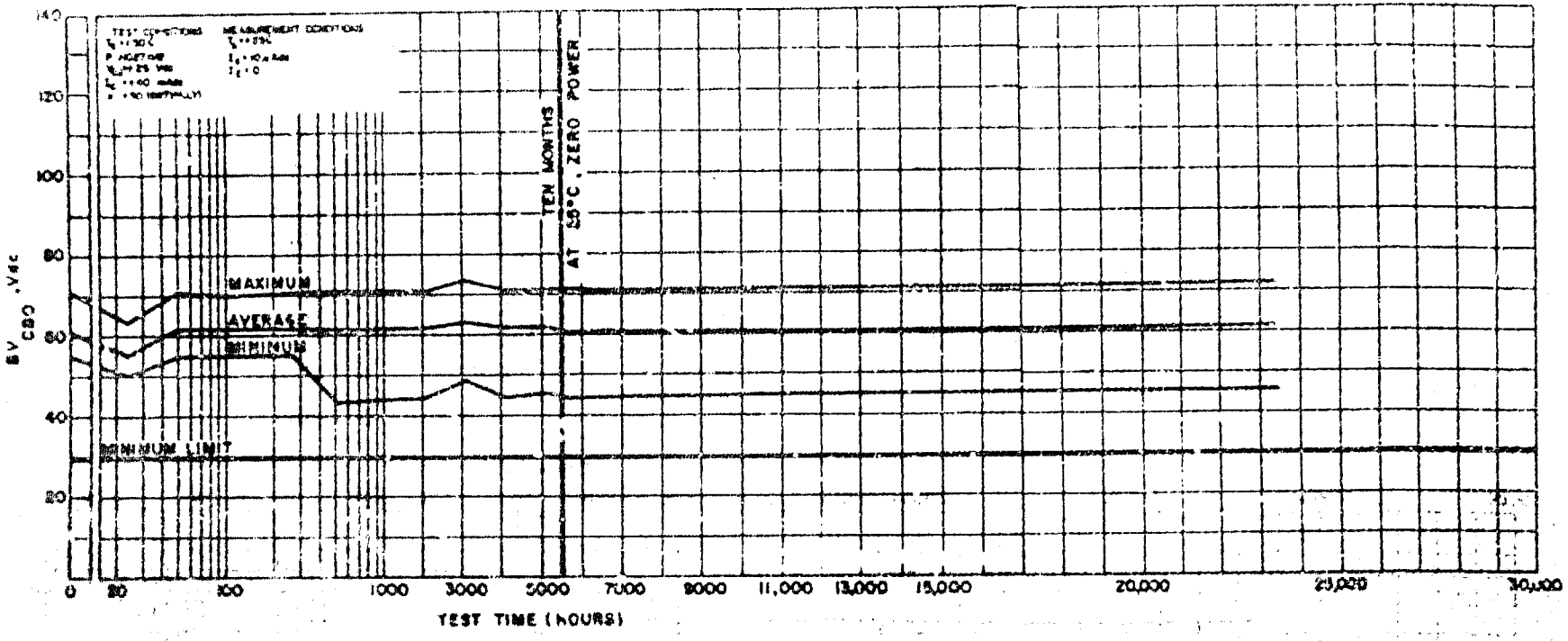
Figure 3-84. Parameter Trend Chart, R2026P1, Phase VI, I_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	69,140	16,920	33,250	104,100
24	61,990	13,929	33,920	96,200
48	61,031	13,996	33,520	94,200
96	61,938	13,516	32,820	134,000
264	61,726	13,590	32,120	92,000
504	60,157	13,171	27,200	92,100
1032	59,940	13,270	26,900	92,000
2016	59,010	13,146	25,800	91,000
3000	61,852	13,300	26,000	93,200
4032	59,900	13,300	25,100	90,100
4463	62,076	14,110	27,900	93,900
5000	59,151	13,137	25,100	93,000
5592	58,820	13,102	27,200	94,000
6720	58,916	13,110	27,000	93,000
6984	61,152	13,700	27,000	93,000
8481	61,674	14,100	27,000	93,000
10992	61,144	14,100	27,700	92,200
12912	58,153	13,100	27,200	94,200
14448	62,672	13,100	27,000	93,000
21384	62,116	13,100	27,000	93,000
23376	62,994	14,120	26,700	93,000

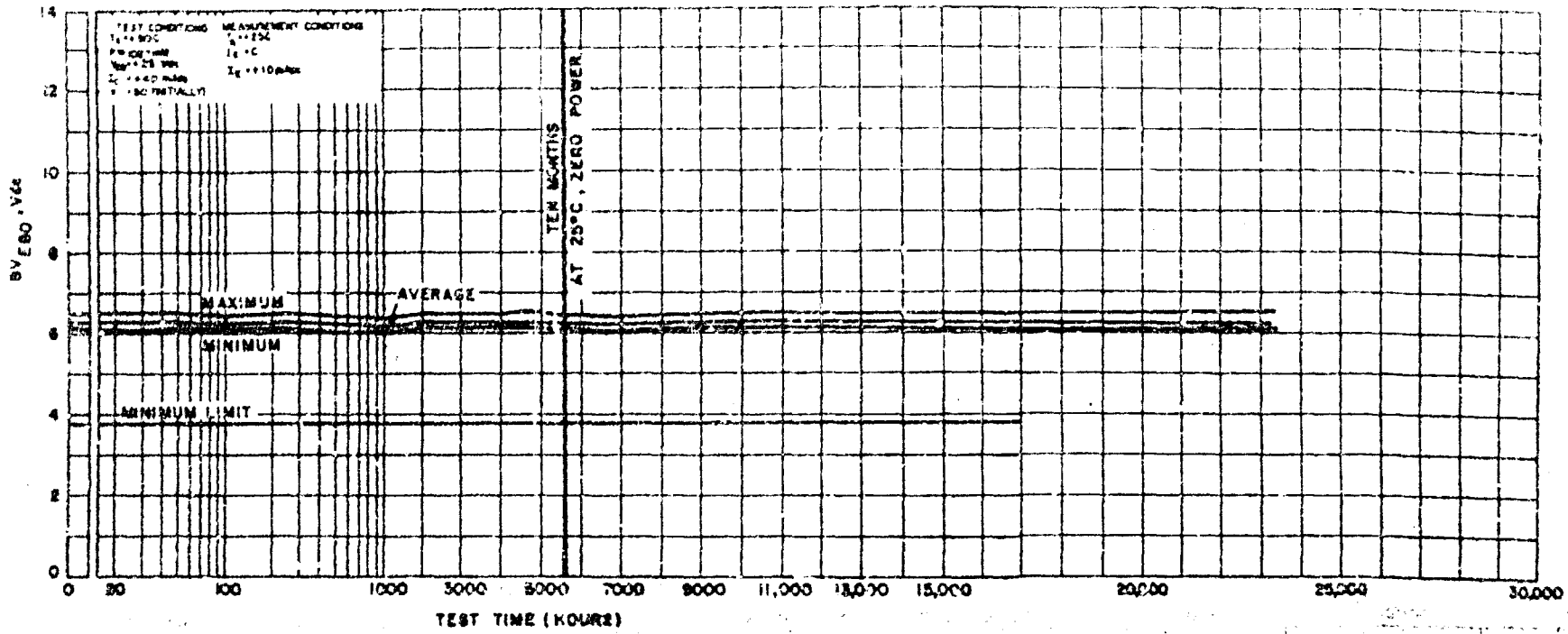
No Failures

Figure 3-86. Parameter Trend Chart, R2028P1, Phase VI, h_{FE}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	83,867	2,954	78,848	91,818
80	84,233	2,364	78,268	89,848
300	83,894	2,858	77,088	90,668
1000	83,864	2,794	77,548	87,368
3000	83,986	2,882	77,580	89,278
5000	84,651	3,144	77,688	91,668
7000	83,735	3,349	77,668	91,898
9000	83,869	3,358	77,738	91,136
11000	83,954	3,241	77,692	91,536
13000	83,862	3,267	77,898	91,253
15000	83,946	3,698	77,848	91,358
20000	83,834	3,853	77,698	91,438
25000	83,672	3,867	77,778	91,198
30000	83,834	3,818	77,678	91,348
35000	83,882	3,833	77,678	91,218
40000	83,883	3,823	77,618	91,868
45000	83,857	3,778	77,898	91,168
50000	83,886	3,798	77,898	91,328
55000	83,814	3,818	77,838	91,998
60000	83,958	3,761	77,698	91,668
65000	83,981	3,798	77,848	91,582

Figure 3-88. Parameter Trend Chart, R2026P1, Phase VI, BV_{CBO}

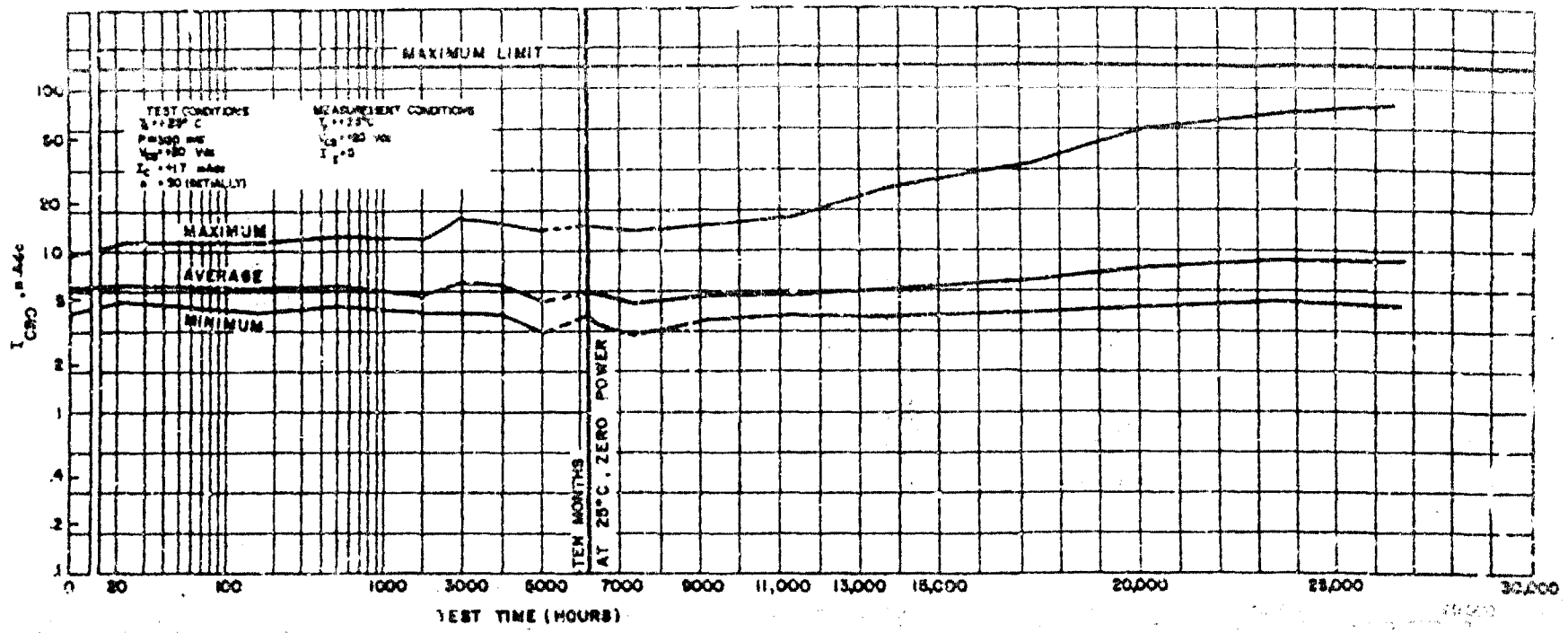


45 PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	6.276	0.009	6.135	6.479
20	6.272	0.008	6.259	6.459
48	6.279	0.009	6.261	6.496
96	6.275	0.009	6.272	6.460
200	6.264	0.008	6.159	6.471
344	6.251	0.013	6.061	6.439
1008	6.157	0.013	6.027	6.334
2016	6.272	0.009	6.110	6.472
3024	6.256	0.009	6.110	6.459
4032	6.248	0.009	6.110	6.469
4403	6.247	0.008	6.122	6.474
5040	6.253	0.009	6.129	6.480
5712	6.248	0.009	6.095	6.461
6720	6.226	0.011	6.077	6.469
7376	6.225	0.009	6.063	6.452
8401	6.251	0.009	6.123	6.468
10080	6.266	0.008	6.148	6.482
12114	6.268	0.009	6.134	6.496
13440	6.251	0.009	6.135	6.466
14184	6.278	0.009	6.134	6.484
15024	6.276	0.008	6.144	6.481

No Failures

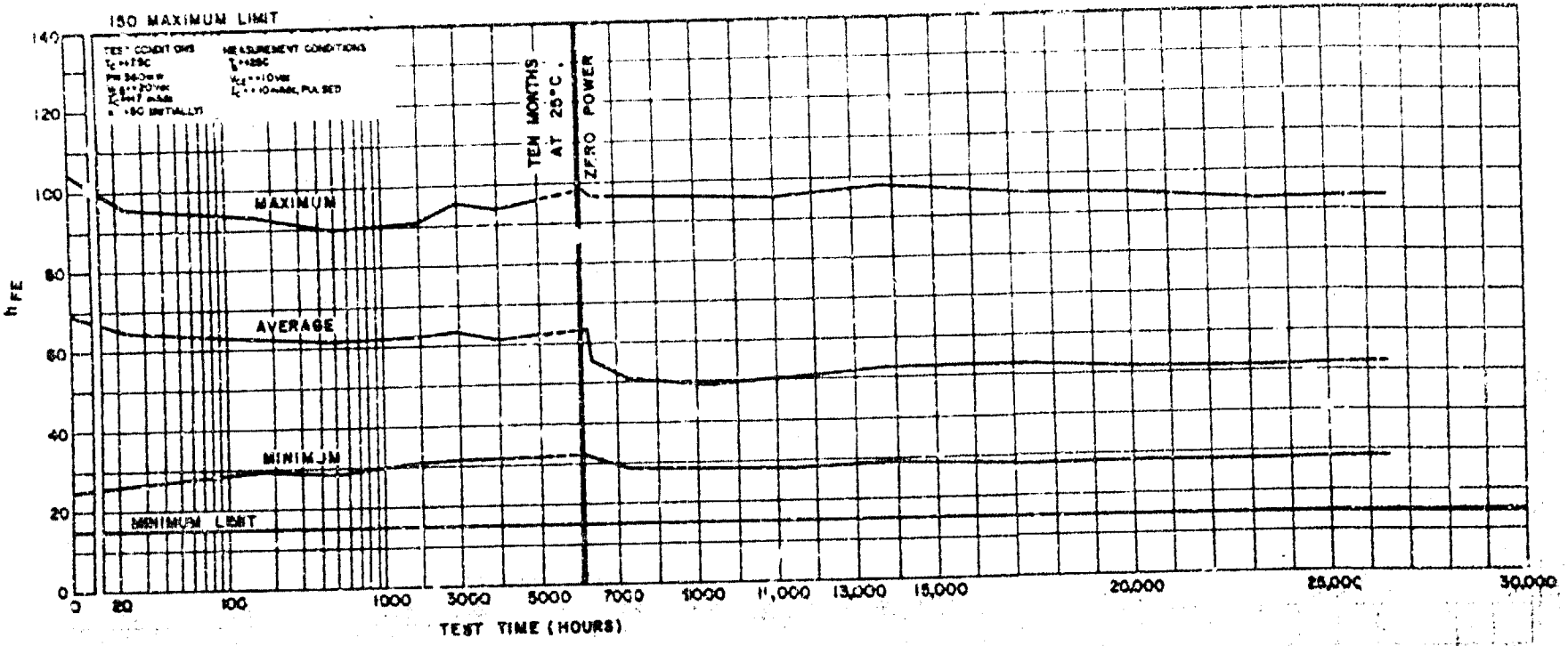
Figure 3-87. Parameter Trend Chart, R2026P1, Phase VI, BV_{EBO}

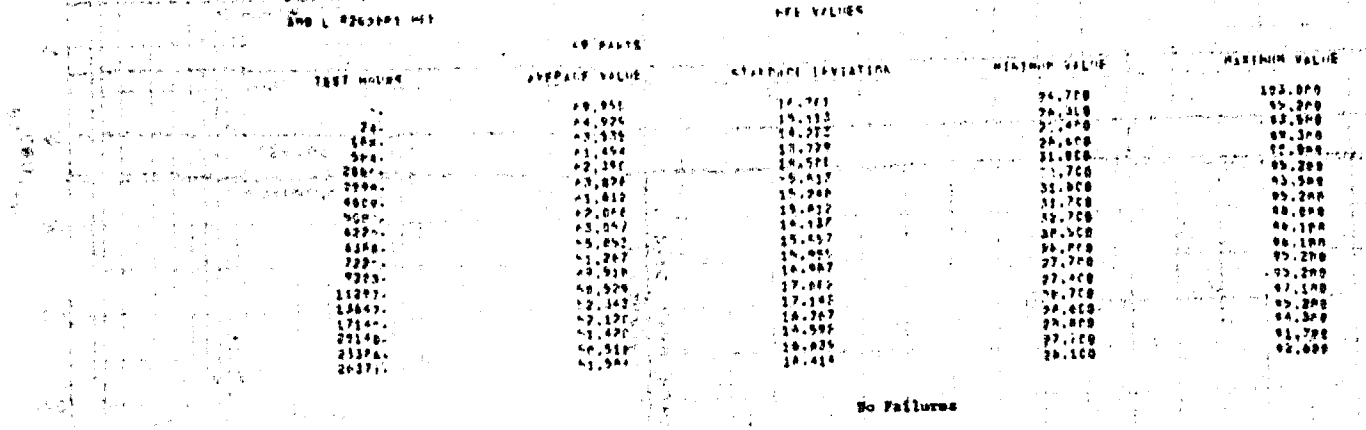


TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	5.039	1.670	4.200	9.963
24.	6.218	1.178	4.800	11.000
548.	5.433	1.926	4.400	11.000
704.	6.210	1.329	4.700	12.000
2844.	5.815	2.551	4.200	12.055
2972.	6.351	1.867	4.300	16.000
4896.	6.231	1.654	4.800	19.000
5004.	6.004	1.837	3.400	13.500
6276.	5.636	1.424	3.200	14.554
6468.	5.318	1.744	3.600	14.998
7224.	4.808	1.565	3.400	13.998
9983.	5.334	1.736	3.998	15.000
11807.	5.794	1.973	4.100	17.000
12647.	6.116	1.734	4.200	26.943
17441.	6.378	1.921	4.100	24.000
25146.	7.765	2.197	4.400	55.000
25884.	8.359	3.031	4.800	66.000
26371.	8.191	3.719	4.400	73.000

No Failures

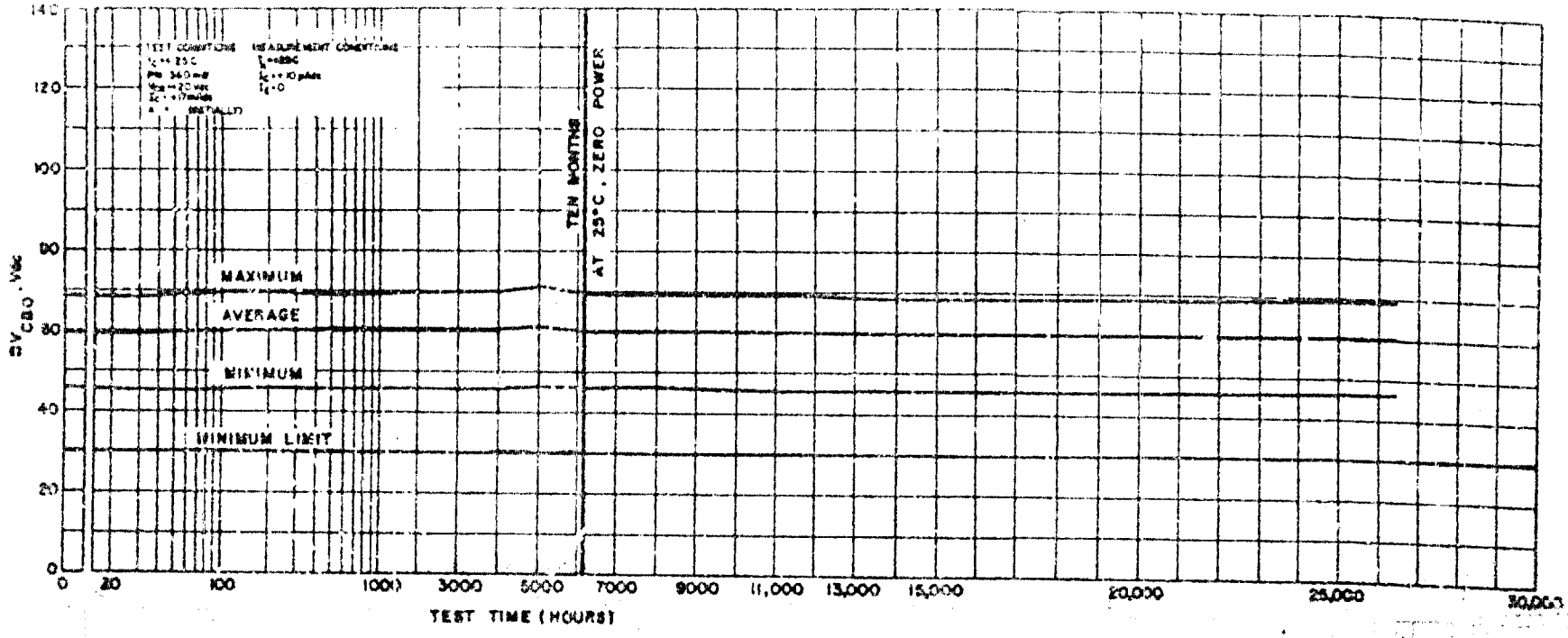
Figure 3-88. Parameter Trend Chart, R2023P1, Ambient Life, I_{CBO}





No Failures

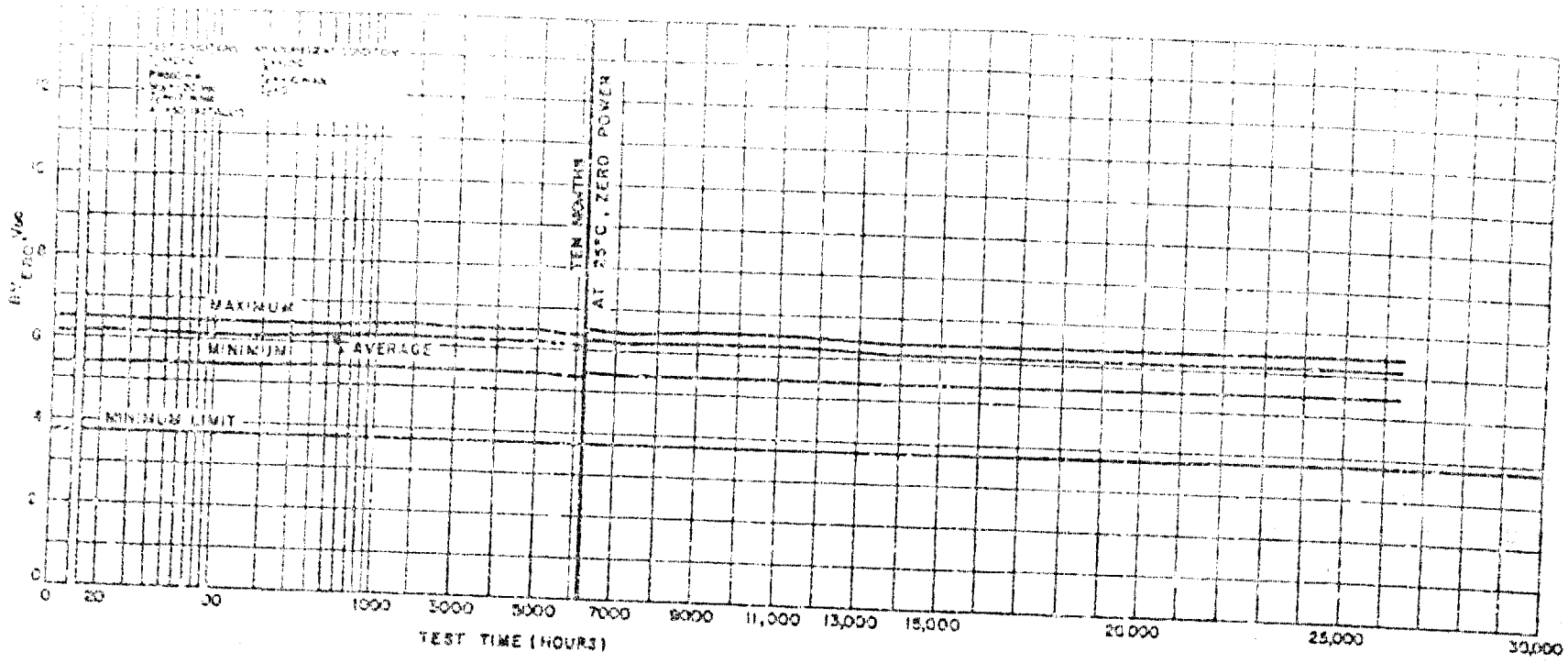
Figure 3-89. Parameter Trend Chart, R2026P1, Ambient Life, h_{FE}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	59.796	1.370	45.996	60.298
24.	59.345	1.416	45.696	61.799
168.	58.695	1.454	45.696	60.198
960.	58.925	1.434	45.696	60.738
2760.	58.931	1.457	45.996	60.298
2928.	59.561	1.464	45.996	60.298
4080.	58.966	1.474	45.996	60.298
5160.	58.771	1.523	44.896	60.298
5328.	58.354	1.562	44.836	71.161
6336.	58.498	1.462	45.419	60.838
7824.	58.441	1.483	45.696	60.148
9288.	58.532	1.418	45.019	60.313
11297.	58.465	1.417	45.976	60.148
13047.	58.353	1.453	45.248	60.998
14714.	58.695	1.432	46.196	60.998
20148.	58.401	1.474	45.248	60.248
23496.	58.493	1.561	46.998	59.138
26772.	58.439	1.529	46.348	60.858
			44.258	60.418

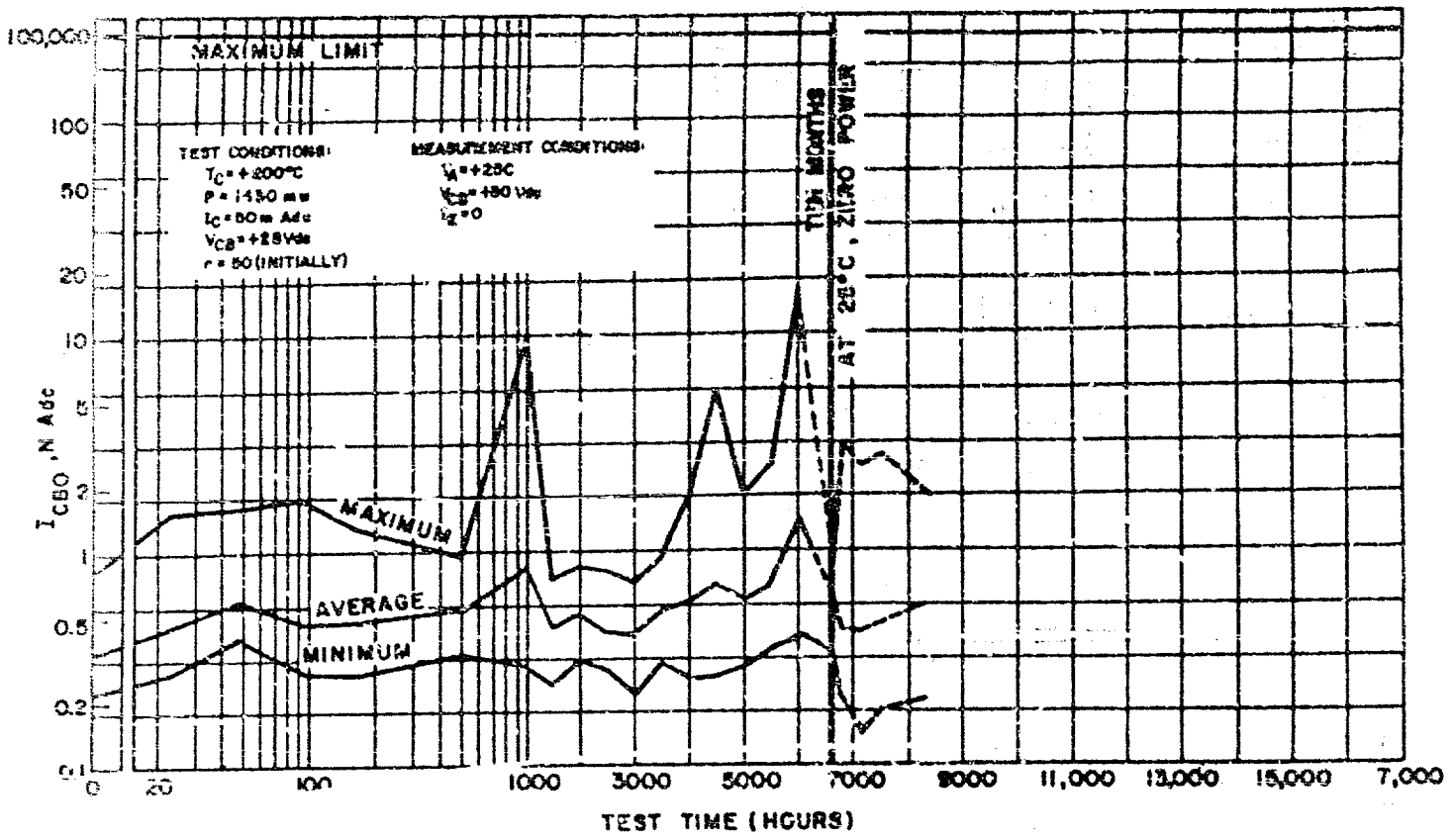
No Failures

Figure 3-90. Parameter Trend Chart, R2026P1, Ambient Life, BV_{CBO}



No Failures

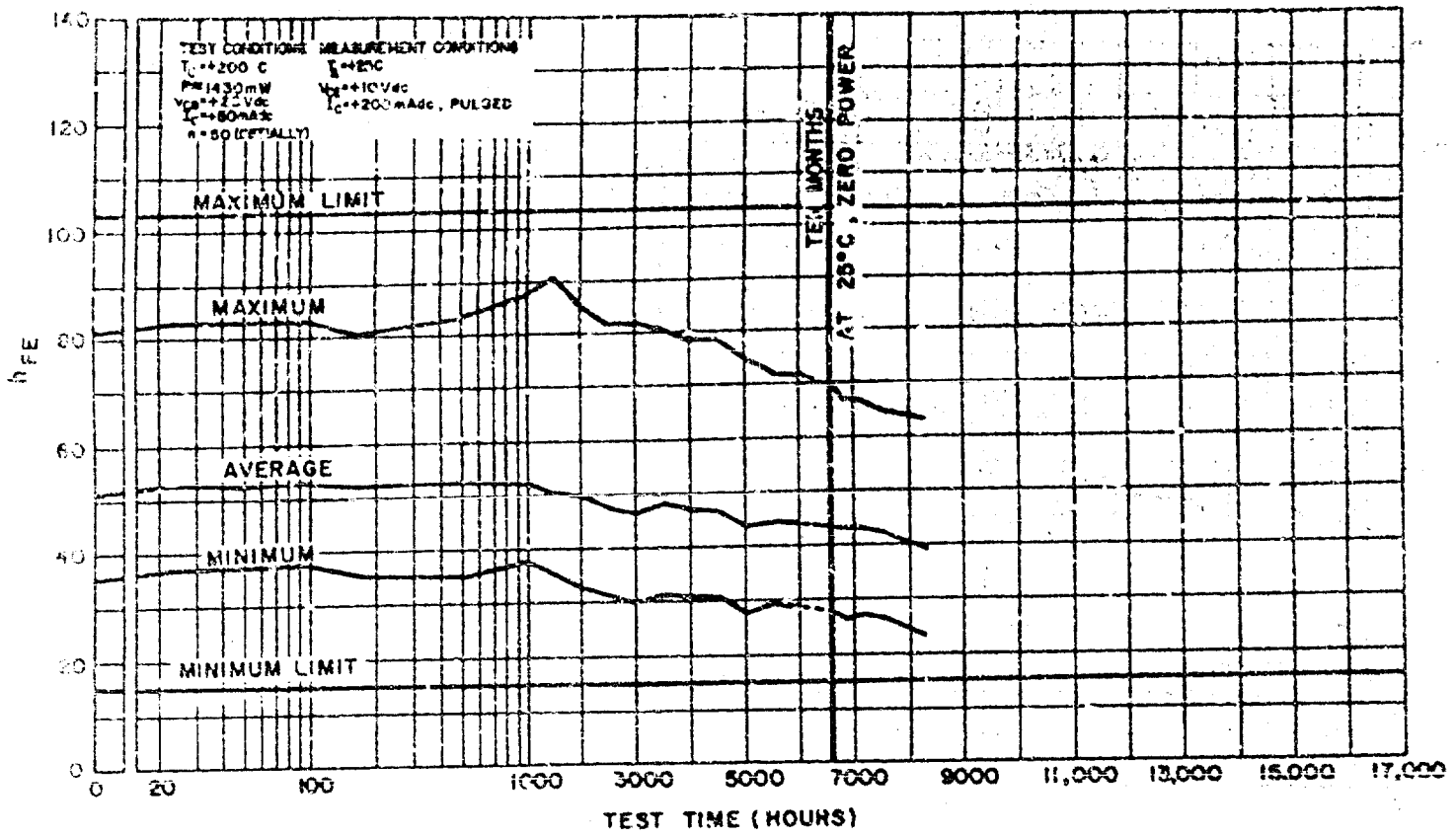
Figure 3-91. Parameter Trend Chart, R2023P1, Ambient Life, BV_{EBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	0.388	0.140	0.230	0.600
24.	0.468	0.282	0.250	1.000
48.	0.419	0.217	0.240	1.000
96.	0.462	0.268	0.200	1.300
168.	0.447	0.180	0.200	1.000
504.	0.538	0.137	0.250	0.900
1008.	0.540	0.425	0.270	0.950
1513.	0.445	0.138	0.240	0.760
2008.	0.504	0.114	0.240	0.640
2520.	0.445	0.128	0.200	0.680
3024.	0.415	0.128	0.200	0.700
3528.	0.502	0.142	0.280	0.880
4032.	0.504	0.094	0.240	1.000
4536.	0.498	0.164	0.240	0.760
5040.	0.509	0.214	0.240	1.000
5578.	0.436	0.418	0.240	2.250
6048.	0.358	0.248	0.240	1.000
6551.	0.669	0.137	0.350	0.880
6818.	0.448	0.205	0.240	0.800
7140.	0.428	0.415	0.240	2.400
7989.	0.486	0.470	0.240	2.300
8304.	0.358	0.374	0.200	1.700

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
14	504	2
	1008	1
	1513	4
	3024	1
	3528	1
	3840	2
	3708	1

Figure 3-92. Parameter Trend Chart, R2C50P1, Phase IV, I_{CBO}

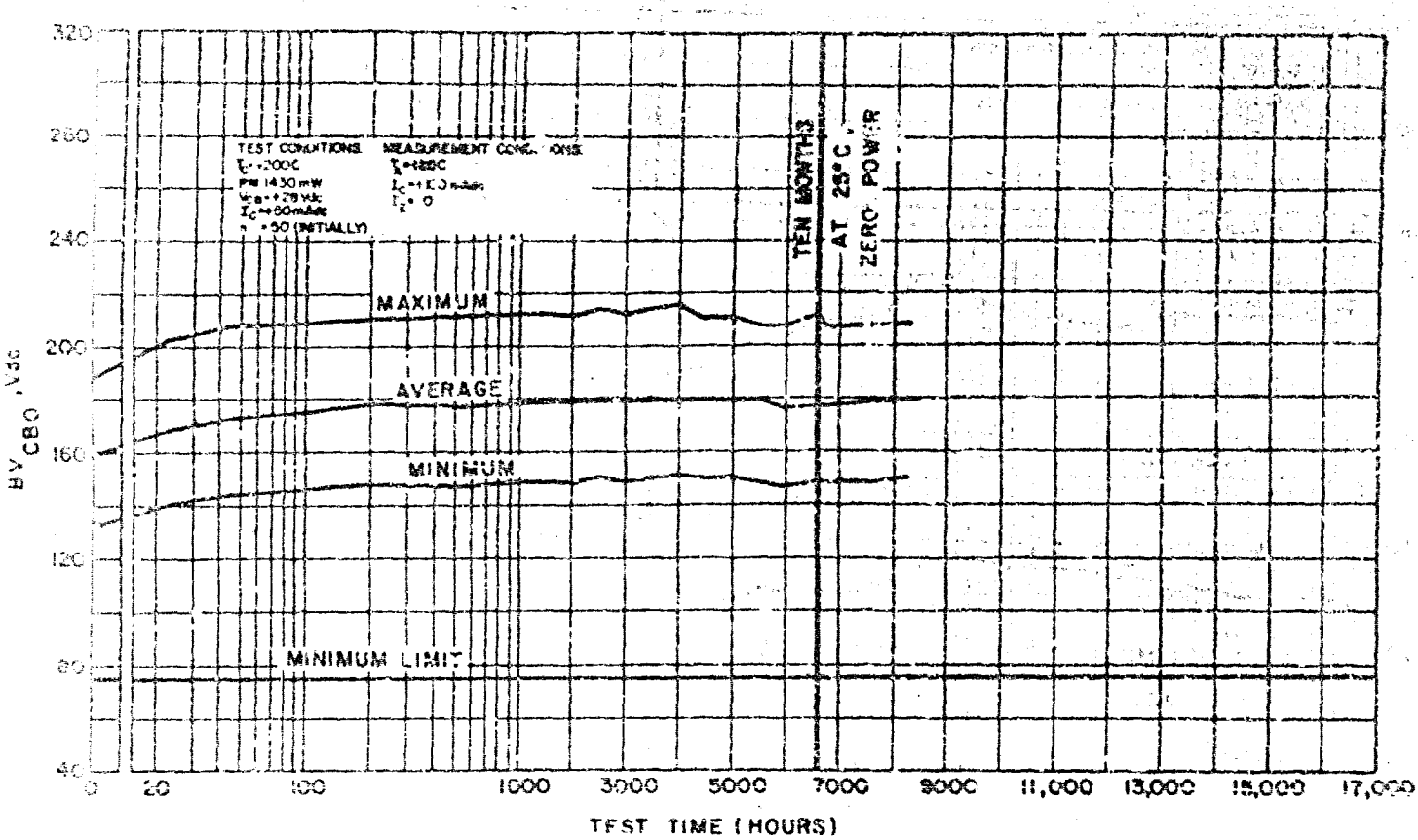


PARTS

TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
[illegible]				

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
14	504	2
	1008	1
	1512	8
	2548	1
	3528	1
	3549	2
	3708	1

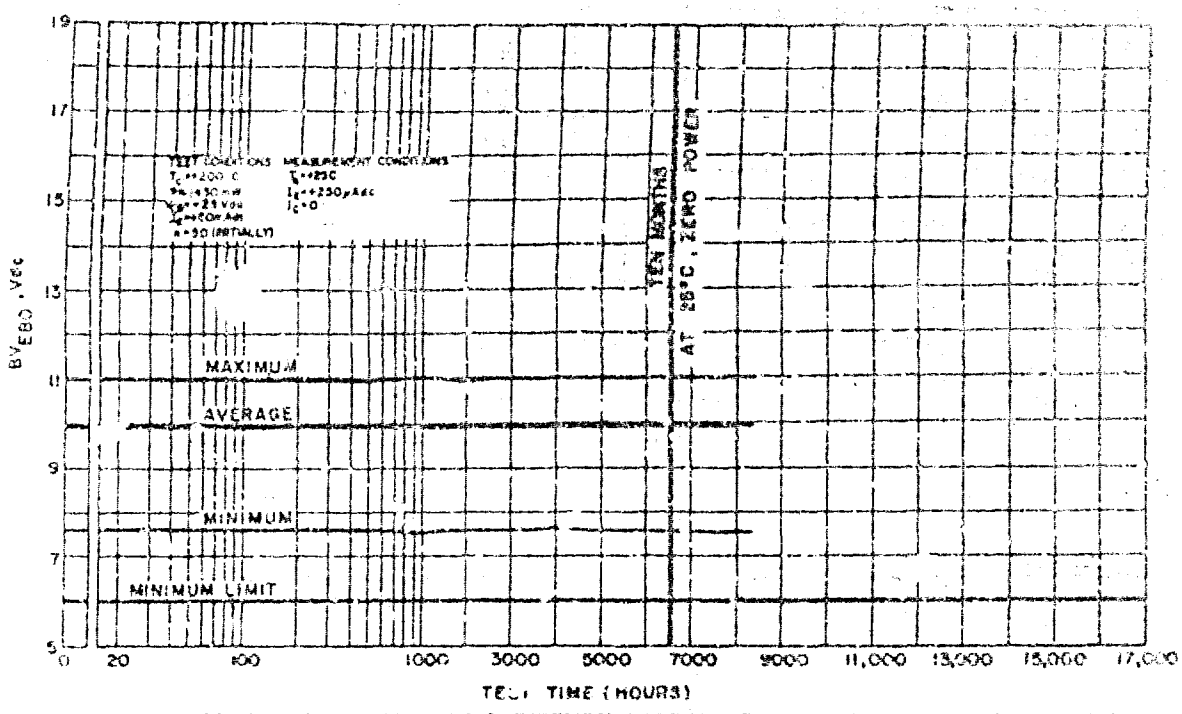
Figure 3-93. Parameter Trend Chart, H2050P1, Phase IV, h_{FE}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	183.7	13.2	134.2	207.0
24	159.2	15.3	141.7	203.0
48	171.1	15.6	144.1	207.0
96	173.1	14.7	145.9	208.2
168	176.5	13.8	148.1	208.7
504	175.1	13.8	147.9	207.4
1008	176.9	14.2	148.9	207.2
1512	176.3	13.3	148.9	207.1
2016	176.1	13.2	149.1	207.1
2520	177.2	13.2	150.1	208.3
3024	177.0	13.4	150.4	208.0
3528	177.1	13.4	150.4	208.0
4032	178.2	13.5	151.4	208.9
4536	178.4	13.7	151.7	208.7
5040	178.2	13.8	151.4	208.7
5544	178.3	13.8	151.4	208.7
6048	178.4	13.8	151.4	208.7
6552	178.4	13.8	151.4	208.7
7056	178.4	13.8	151.4	208.7
7560	178.4	13.8	151.4	208.7
8064	178.4	13.8	151.4	208.7
8568	178.4	13.8	151.4	208.7
9072	178.4	13.8	151.4	208.7
9576	178.4	13.8	151.4	208.7
10080	178.4	13.8	151.4	208.7
10584	178.4	13.8	151.4	208.7
11088	178.4	13.8	151.4	208.7
11592	178.4	13.8	151.4	208.7
12096	178.4	13.8	151.4	208.7
12600	178.4	13.8	151.4	208.7
13104	178.4	13.8	151.4	208.7
13608	178.4	13.8	151.4	208.7
14112	178.4	13.8	151.4	208.7
14616	178.4	13.8	151.4	208.7
15120	178.4	13.8	151.4	208.7
15624	178.4	13.8	151.4	208.7
16128	178.4	13.8	151.4	208.7
16632	178.4	13.8	151.4	208.7
17136	178.4	13.8	151.4	208.7

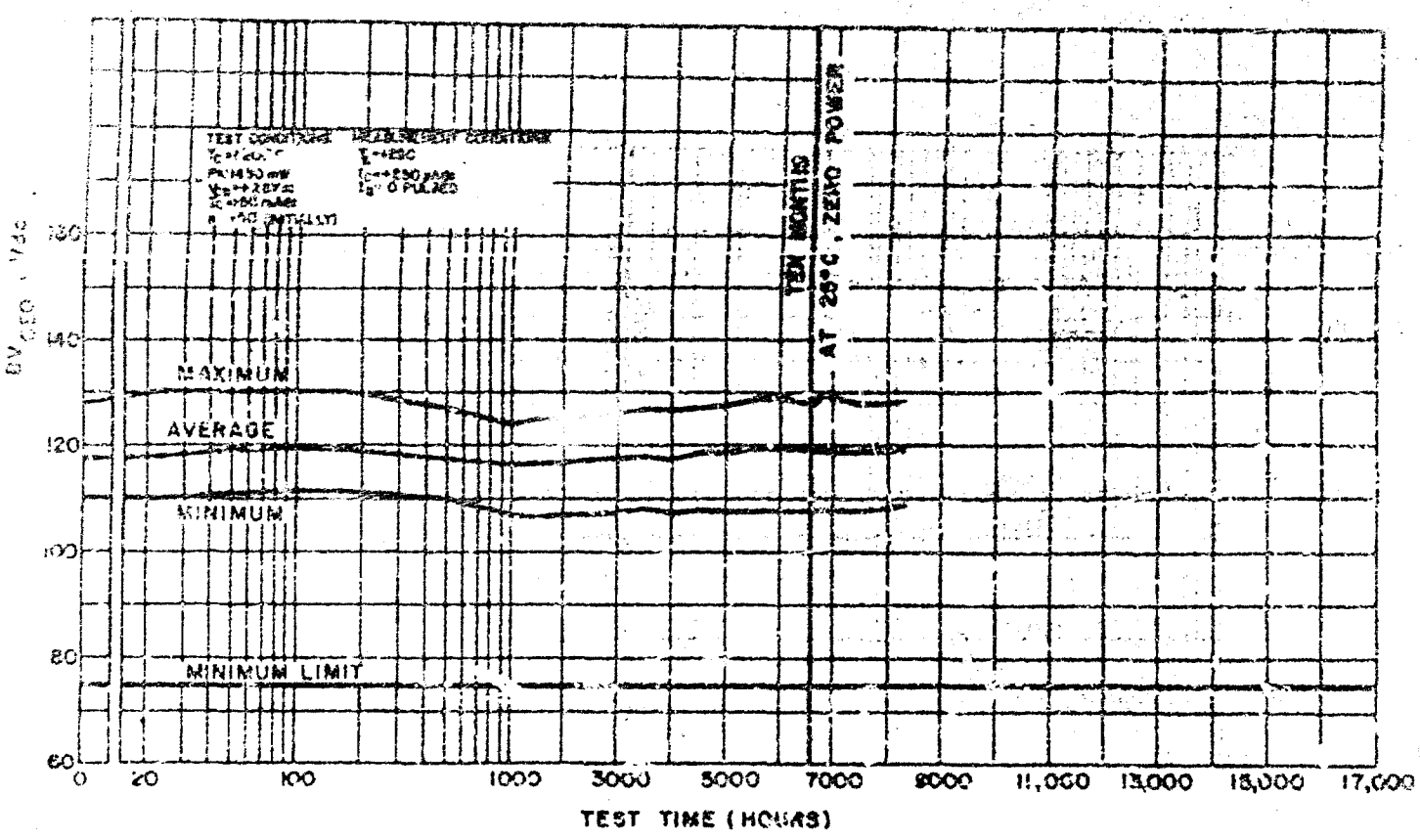
TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
14	504	2
	1008	1
	1512	6
	3360	1
	3528	1
	3849	2
	3864	1

Figure 3-94. Parameter Trend Chart, R2050P1, Phase IV, BV_{CBO}



TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
11	754	2
	1904	
	[illegible]2	8
	[illegible]3	1
	7520	1
	8543	2
	9700	1

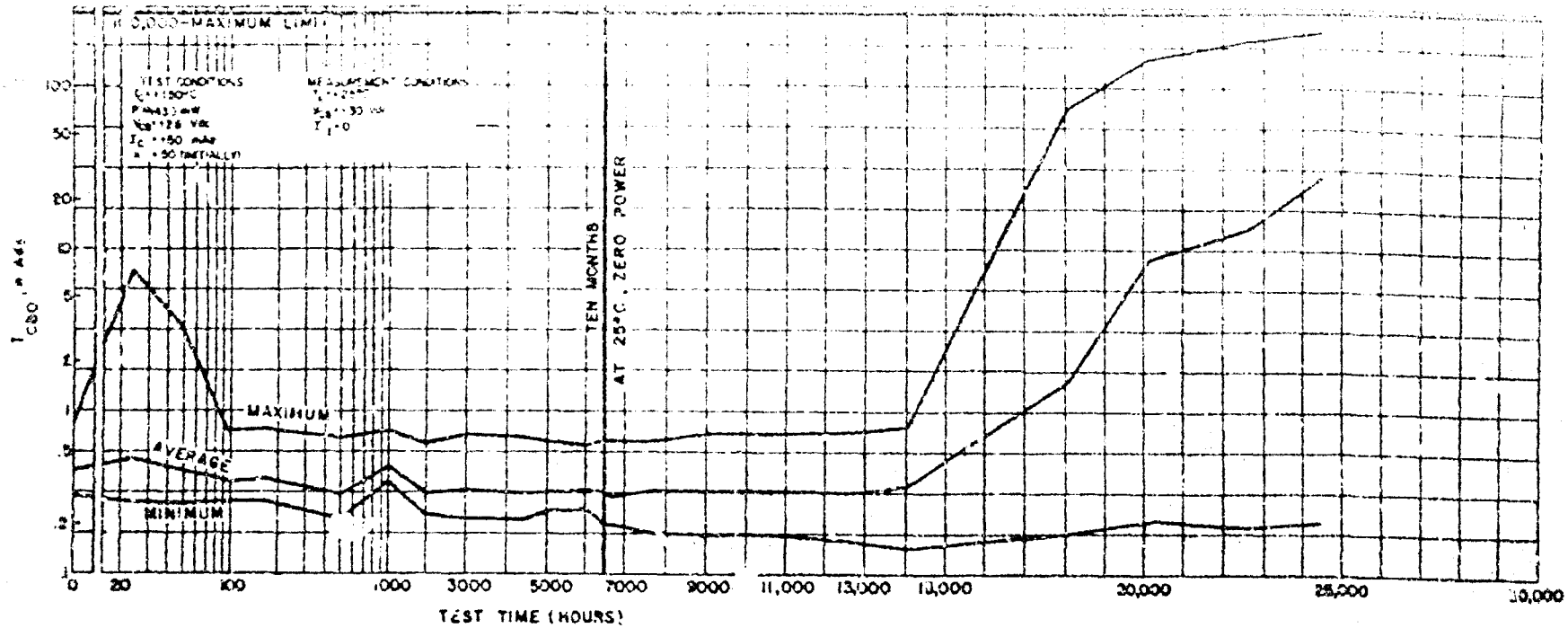
Figure 3-95. Parameter Trend Chart, R2050P1, Phase IV, BV_{EBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	127.5	6.52	111.0	147.0
20	116.053	4.004	111.0	130.0
100	118.733	5.139	111.0	130.0
168	119.167	4.652	111.0	130.0
1008	119.267	4.277	111.000	130.000
3008	117.997	3.892	111.000	140.000
5008	118.187	4.141	111.000	123.000
7512	118.697	4.1	110.000	130.000
9008	119.477	4.212	111.000	130.000
11008	117.107	4.039	111.000	125.000
13008	117.923	4.007	111.000	130.000
15008	117.007	4.038	111.000	126.000
17008	117.150	4.765	111.000	126.000
19008	118.053	4.053	111.000	127.000
20708	118.677	4.067	111.000	126.000
23708	119.120	4.518	111.000	126.000
26208	119.130	4.364	111.000	126.000
28508	119.727	4.162	111.000	127.000
30108	118.573	4.001	111.000	126.000
31408	118.723	4.849	111.000	126.000
32908	118.913	4.003	111.000	127.000
34708	119.233	4.947	111.000	128.000

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
14	504	2
	1906	1
	1812	6
	3343	1
	3528	1
	3548	1
	3788	1

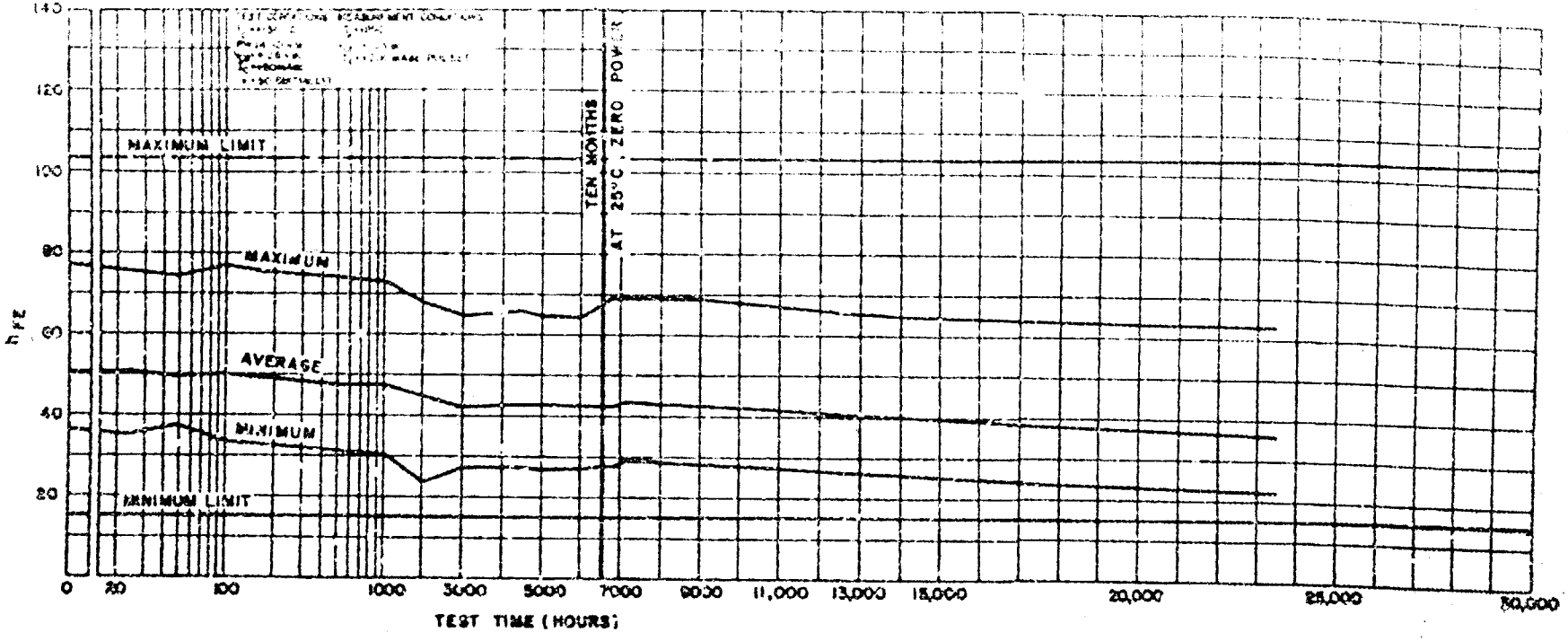
Figure 3-98. Parameter Trend Chart, R2050P1, Phase IV, BV_{CEO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0+	0.448	0.184	0.230	2.040
24+	0.539	1.045	0.270	7.960
48+	0.437	0.466	0.270	4.480
96+	0.375	0.092	0.260	0.790
168+	0.394	0.290	0.290	4.760
504+	0.525	0.075	0.220	0.680
1008+	0.559	0.076	0.280	0.790
2016+	0.510	0.071	0.306	0.530
3000+	0.336	0.092	0.220	0.770
4465+	0.329	0.083	0.220	0.660
5040+	0.326	0.073	0.240	0.670
6515+	0.337	0.075	0.250	0.690
6990+	0.337	0.095	0.280	0.660
7210+	0.294	0.094	0.260	0.660
7951+	0.357	0.056	0.295	0.590
7954+	0.339	0.095	0.312	0.660
9.84+	0.317	0.110	0.170	0.700
10032+	0.339	0.117	0.179	0.740
12003+	0.332	0.129	0.146	0.796
14047+	0.366	0.141	0.198	0.840
16176+	0.831	2.589	0.440	17.220
18.36+	2.159	11.883	0.260	62.880
38197+	9.371	51.835	0.270	346.000
42478+	13.477	78.589	0.220	566.000
44382+	37.135	238.946	0.240	1378.000

TOTAL FAILURES — TIME TO FAILURE (HRS) — QUANTITY

Figure 3-97. Parameter Trend Chart, R2050P1, Phase V, I_{CBO}



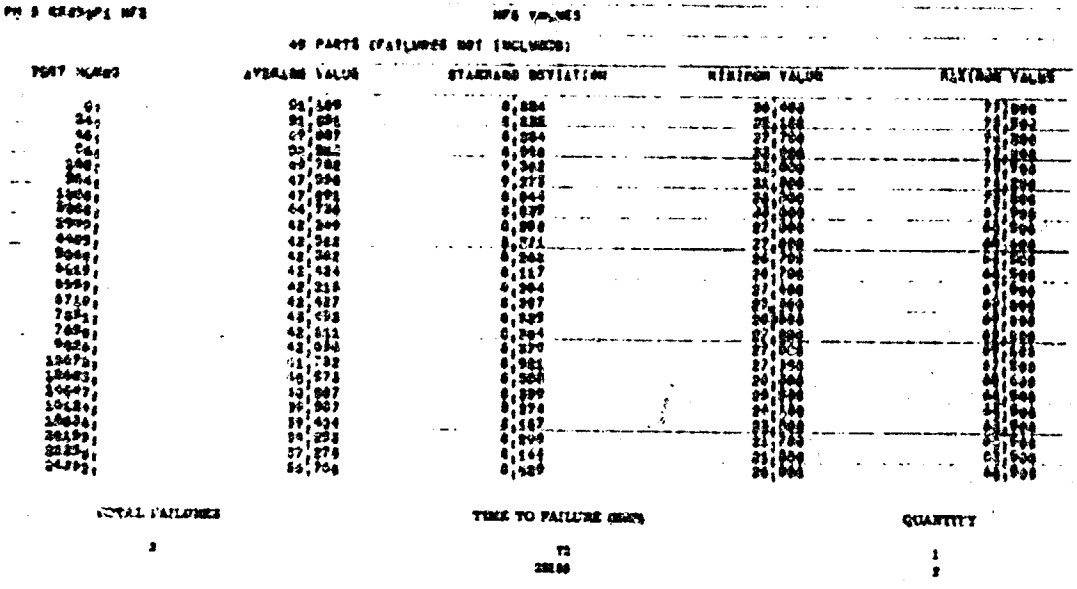
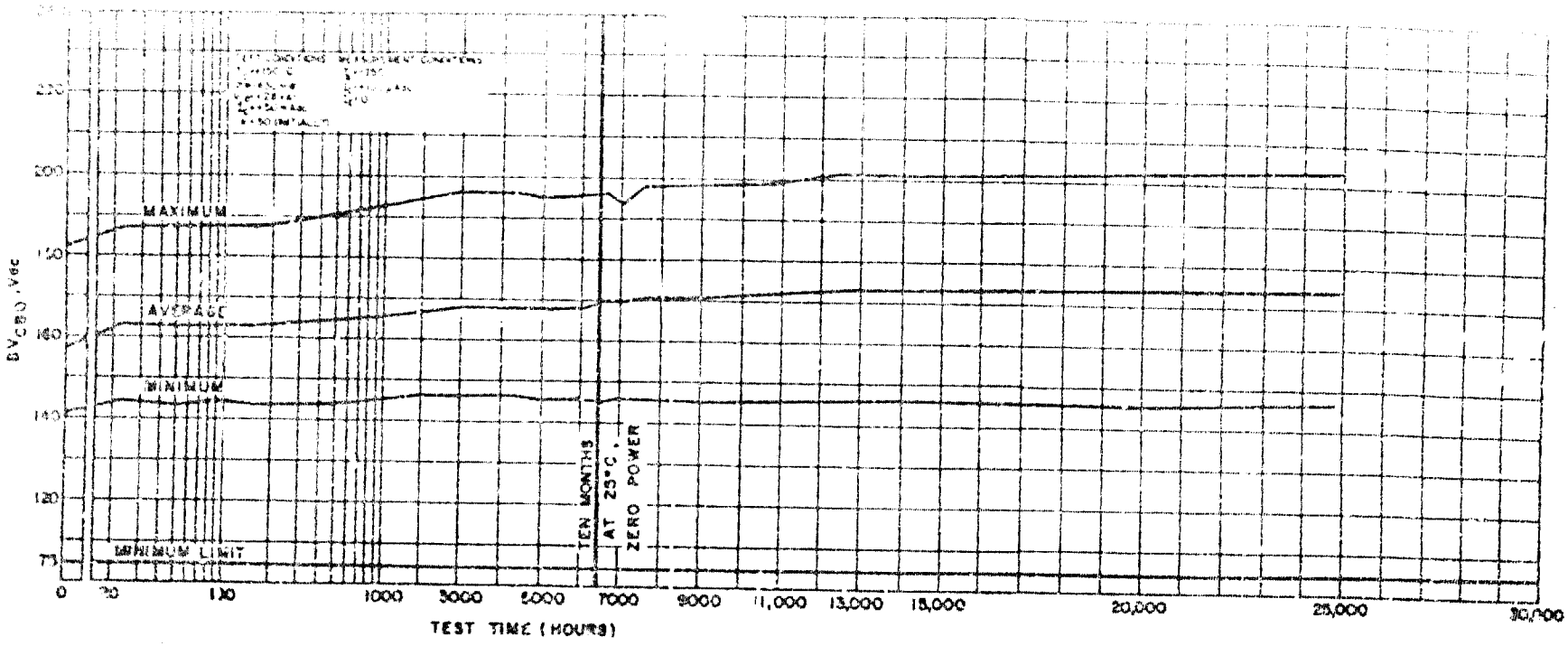


Figure 3-98. Parameter Trend Chart, R2050P1, Phase V, h_{FE}



PH 5 R2050P1 BVCBO

BVCBO VALUES IN VOLTS

45 PARTS (FAILURES NOT INCLUDED)

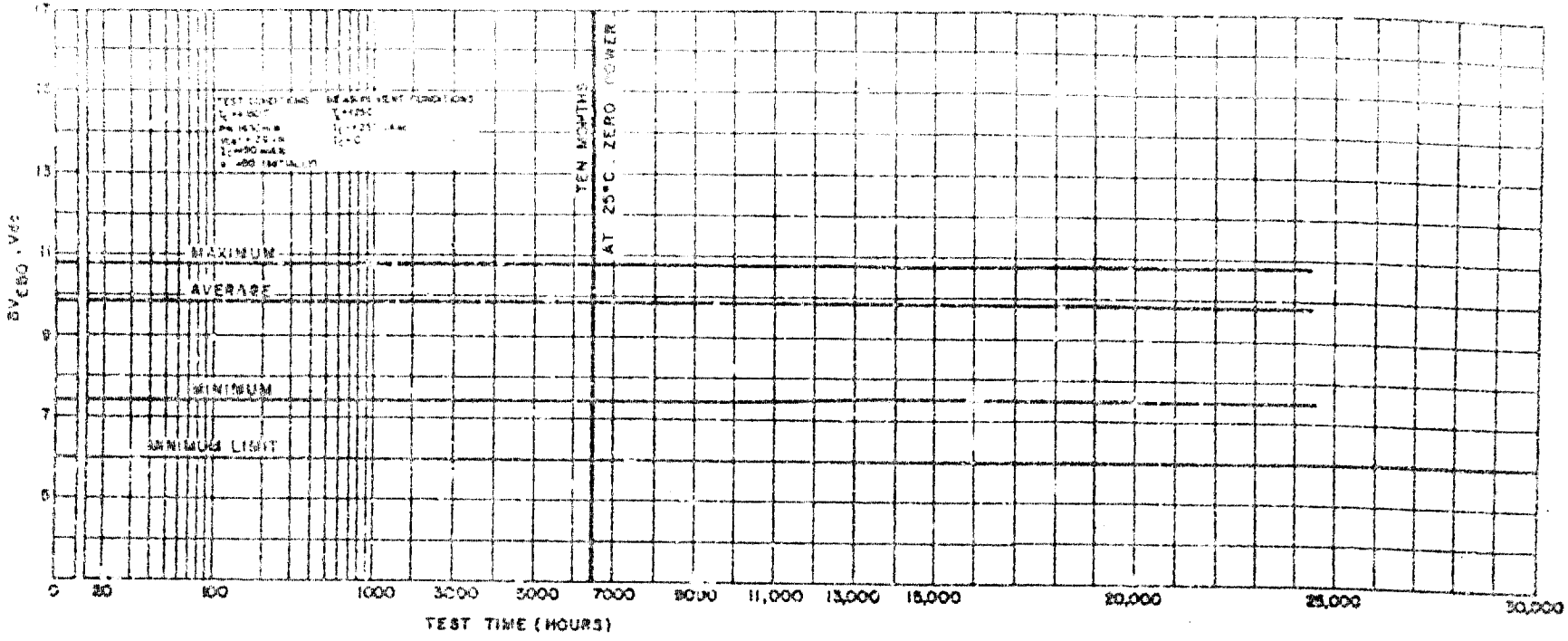
TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0,	156,402	10,089	146,996	181,988
24,	160,731	11,270	151,856	184,988
48,	161,496	11,326	152,988	185,988
96,	161,389	11,417	151,988	185,988
144,	161,196	11,387	151,988	185,188
504,	162,917	11,746	152,996	186,996
1416,	165,691	12,119	153,188	189,188
2,664,	164,693	12,093	152,988	189,988
3,792,	161,384	11,853	148,996	185,988
4416,	161,567	12,538	148,996	185,988
5088,	161,834	12,955	148,988	185,988
5,592,	161,956	13,048	148,988	185,988
6552,	160,964	13,284	148,988	185,988
6720,	160,672	13,468	148,988	185,988
7056,	160,782	13,338	148,988	185,988
7608,	170,056	16,615	148,988	185,988
8256,	170,869	13,952	148,988	185,988
10472,	171,598	14,089	148,988	185,988
13608,	172,431	14,448	148,988	185,988
14249,	172,742	14,969	148,988	185,988
18184,	173,478	14,807	148,988	185,988
18936,	173,976	14,288	148,988	185,988
20,390,	173,934	13,829	148,988	185,988
22336,	173,349	13,281	148,988	185,988
24392	174,891	13,329	155,188	185,988

TOTAL FAILURES: 3

TIME TO FAILURE (HRS): 72, 20156

QUANTITY: 1, 2

Figure 3-53. Parameter Trend Chart, R2050P1, Phase V, BV_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	9.995	0.046	9.928	10.069
24	9.858	0.042	9.819	10.001
48	9.914	0.041	9.859	10.019
96	9.842	0.042	9.809	10.000
168	9.787	0.039	9.718	10.003
264	9.788	0.036	9.728	10.000
336	9.773	0.051	9.683	10.000
504	9.804	0.043	9.723	10.000
672	9.818	0.033	9.736	10.000
840	9.804	0.038	9.736	10.000
1008	9.809	0.033	9.723	10.000
1176	9.819	0.042	9.736	10.000
1344	9.797	0.038	9.736	10.000
1512	9.794	0.036	9.736	10.000
1680	9.806	0.032	9.736	10.000
1848	9.813	0.034	9.736	10.000
2016	9.808	0.034	9.736	10.000
2184	9.808	0.028	9.736	10.000
2352	9.805	0.028	9.736	10.000
2520	9.799	0.028	9.736	10.000
2688	9.796	0.028	9.736	10.000
2856	9.797	0.028	9.736	10.000
3024	9.779	0.028	9.736	10.000
3192	9.791	0.028	9.736	10.000
3360	9.798	0.028	9.736	10.000

TOTAL FAILURES: 0

TIME TO FAILURE (HRS): 72, 2619

QUANTITY: 1, 1

Figure 3-100. Parameter Trend Chart, R2050P1, Phase V, BV_{EBO}

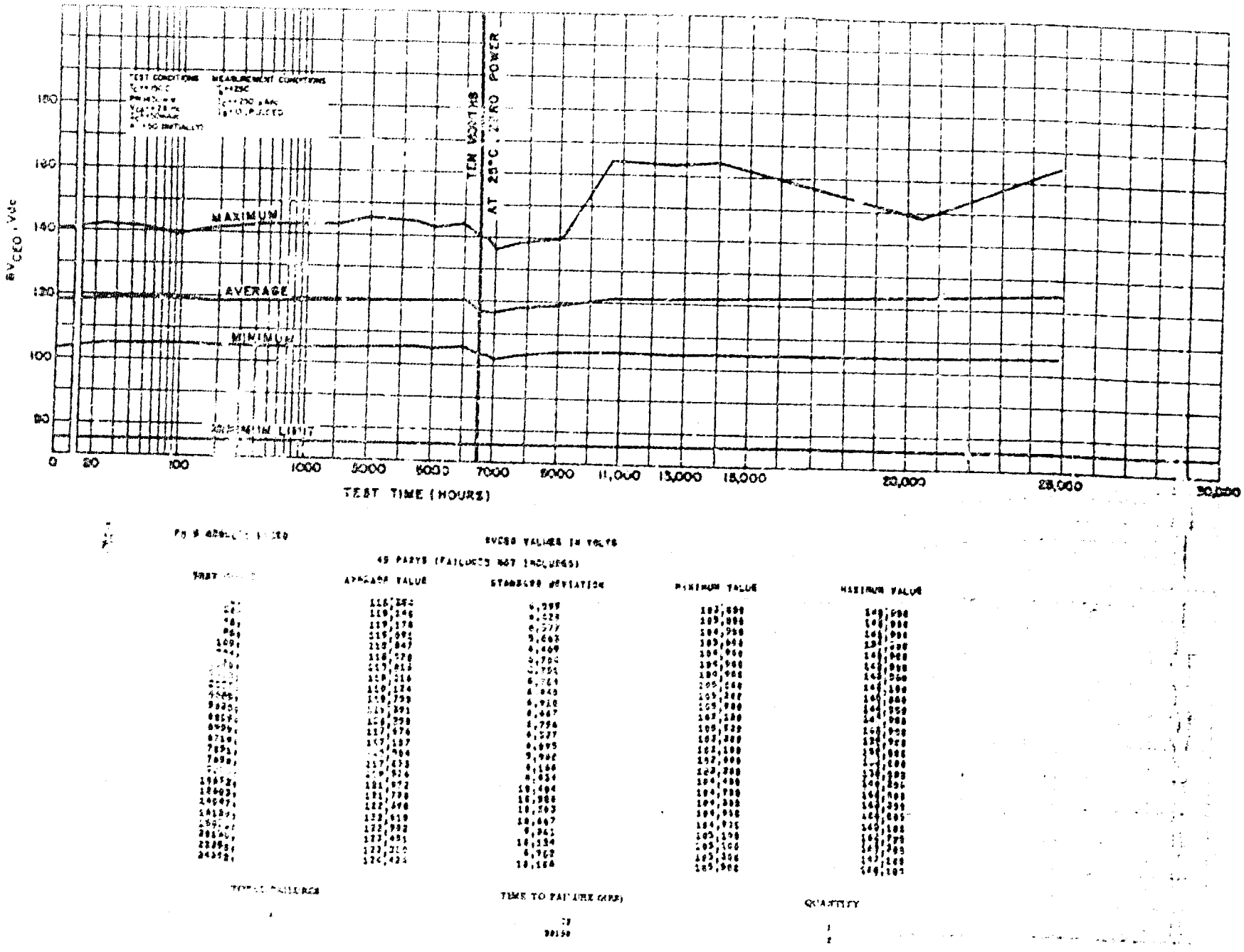
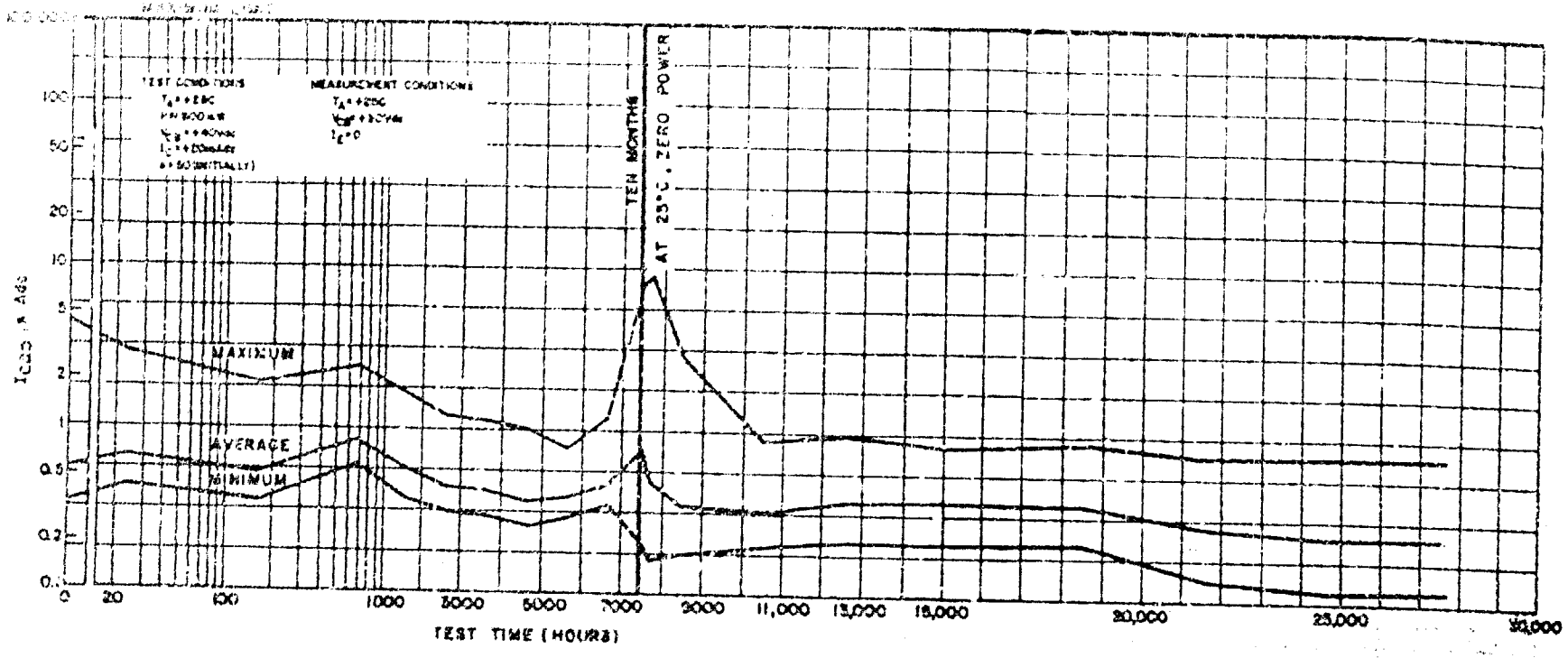


Figure 3-101. Parameter Trend Chart, R2050P1, Phase V, BV_{CEO}



	0.574	0.161	0.240	4.688
	0.641	0.348	0.458	3.688
	2.539	0.237	0.365	1.988
	0.670	0.295	0.625	1.398
	0.581	0.157	0.370	1.688
	0.427	0.151	0.288	1.688
	0.436	0.160	0.290	1.209
	0.420	0.131	0.290	1.198
	0.398	0.106	0.260	1.038
	0.419	0.144	0.295	0.778
	0.574	1.073	0.395	1.398
	0.514	0.933	0.290	0.878
	0.362	0.368	0.160	0.884
	0.334	0.147	0.160	2.988
	0.364	0.144	0.290	1.988
	0.303	0.127	0.270	0.944
	0.277	0.138	0.220	0.698
	0.273	0.132	0.220	0.986
	0.257	0.124	0.113	0.738
	0.274	0.125	0.198	0.778

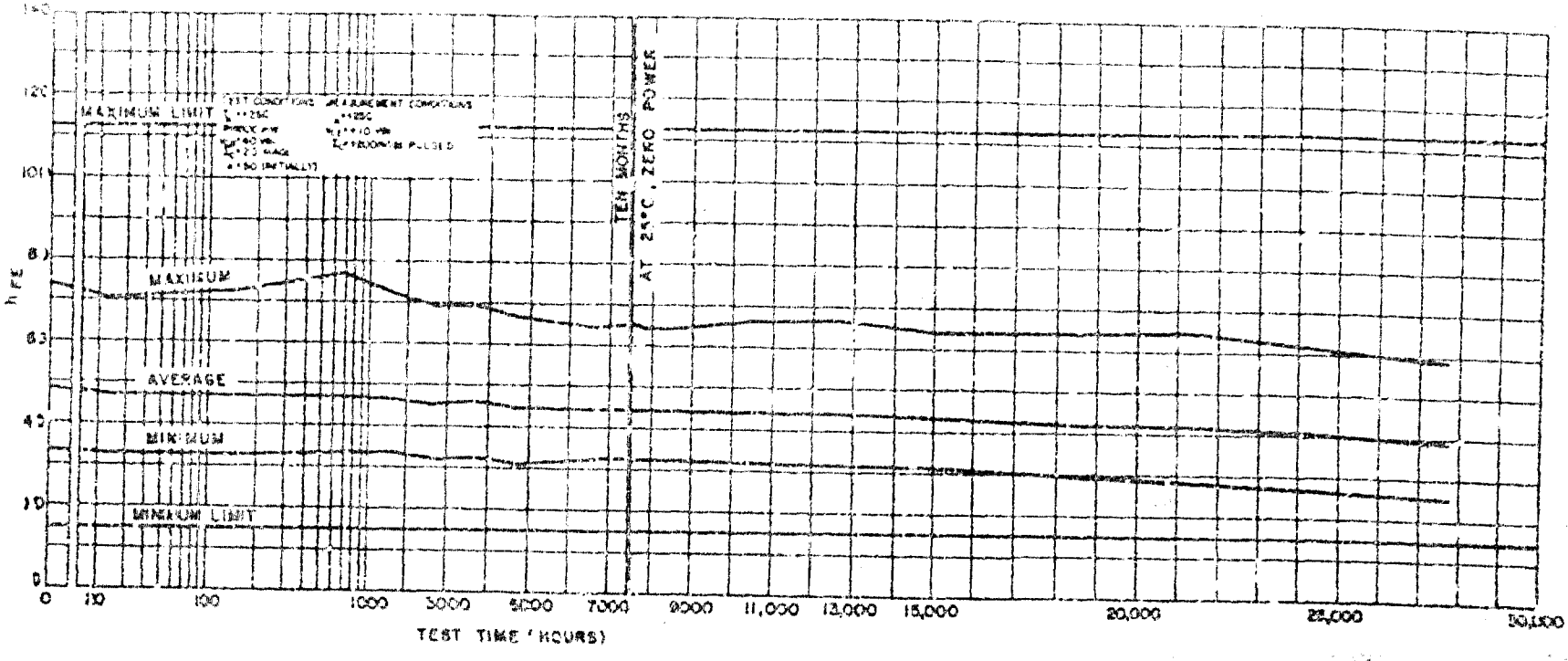
TOTAL FAILURES: 3

TIME TO FAILURE (hrs)

QUANTITY

1
1

Figure 3-102. Parameter Trend Chart, R2050P1, Ambient Life, I_{CBO}



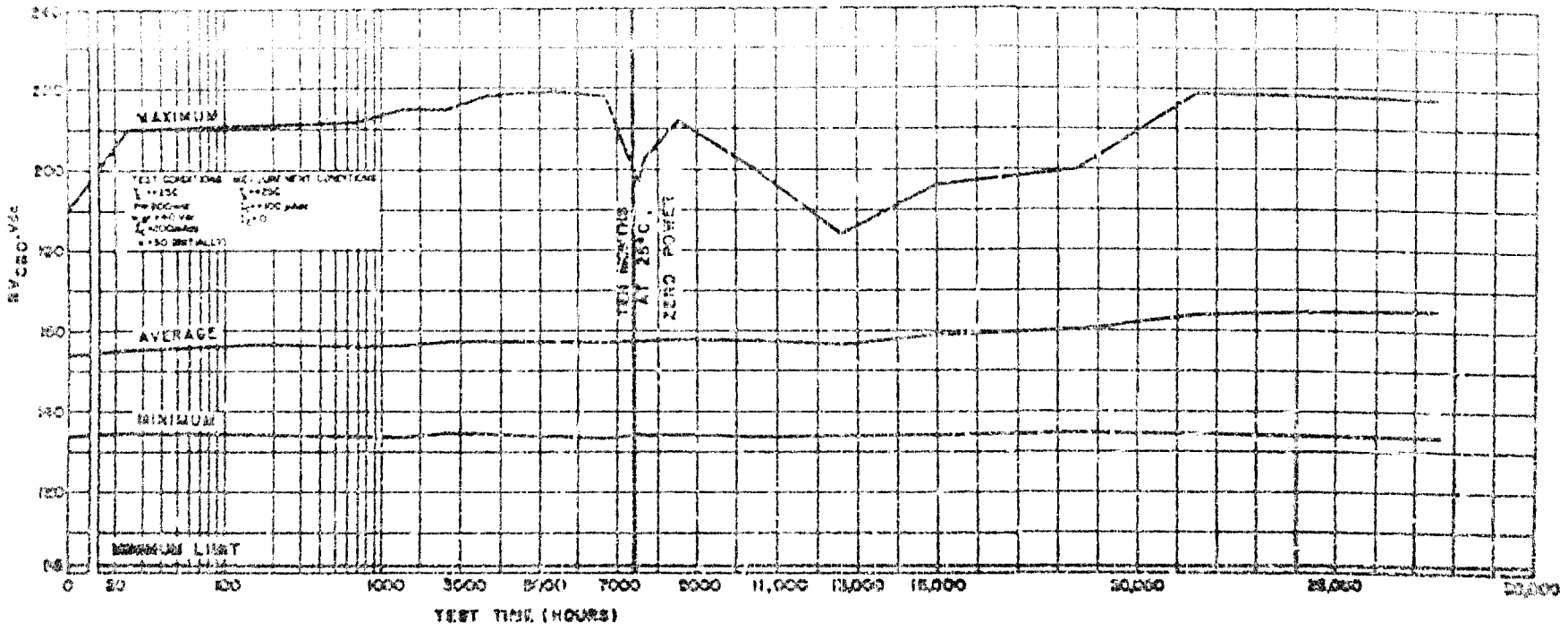
TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	48.154	6.144	33.000	74.000
24.	47.308	7.882	33.000	75.000
48.	47.385	7.781	33.000	72.000
172.	47.385	7.938	33.000	73.000
500.	47.231	7.436	33.000	71.000
1032.	46.538	7.692	32.000	69.000
1572.	46.385	7.547	32.000	69.000
2076.	46.385	7.616	31.000	68.000
2556.	46.077	7.253	31.000	68.000
3036.	45.846	6.359	32.000	64.000
3516.	45.000	7.078	33.000	65.000
4020.	44.692	6.987	32.000	64.000
4524.	44.462	6.823	32.000	64.000
5004.	44.000	7.505	30.000	63.000
5484.	44.308	7.395	32.000	66.000
6000.	44.000	7.113	31.000	64.000
15492.	41.538	7.574	29.000	63.000
21480.	42.269	7.367	28.000	64.000
24516.	40.357	6.878	27.000	61.000
27588.	39.154	6.752	25.000	58.000

TOTAL FAILURES
1

TIME TO FAILURE (HRS)
1488
20976

QUANTITY
1
1

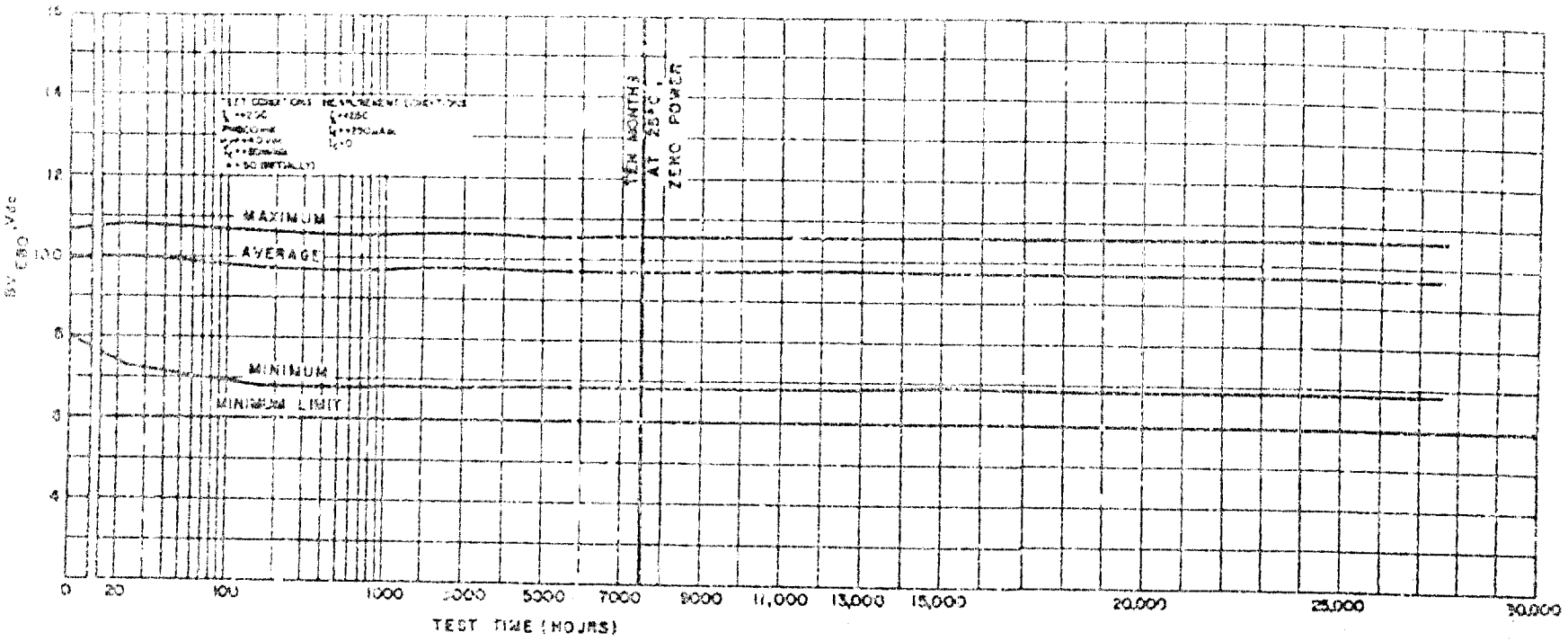
Figure 3-103. Parameter Trend Chart, R2050P1, Ambient Life, h_{FE}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	170.818	13.406	136,000	190.000
24.	155.417	14,004	130,000	182.000
168.	167.778	14,644	130,000	214.000
672.	167.857	14,805	134,000	212.000
1856.	172.903	14,173	134,500	213.250
3672.	170.187	14,731	138,000	215.125
5472.	168.250	15,672	134,000	210.250
6672.	167.962	14,243	134,000	213.000
5856.	167.962	14,816	134,000	213.188
6672.	167.750	14,349	133,000	214.000
7512.	168.441	15,044	138,501	217.250
7752.	168.417	15,274	134,033	213.000
8583.	168.538	15,026	134,646	213.188
11521.	168.269	15,142	134,033	210.000
13819.	167.485	15,757	134,500	207.000
14305.	168.746	15,934	134,002	206.000
15850.	168.478	15,813	134,000	203.000
21648.	168.231	16,667	134,000	210.000
24715.	168.081	16,101	134,000	210.000
27589.	168.000	16,276	134,000	207.000

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
2	5856	1
	25716	1

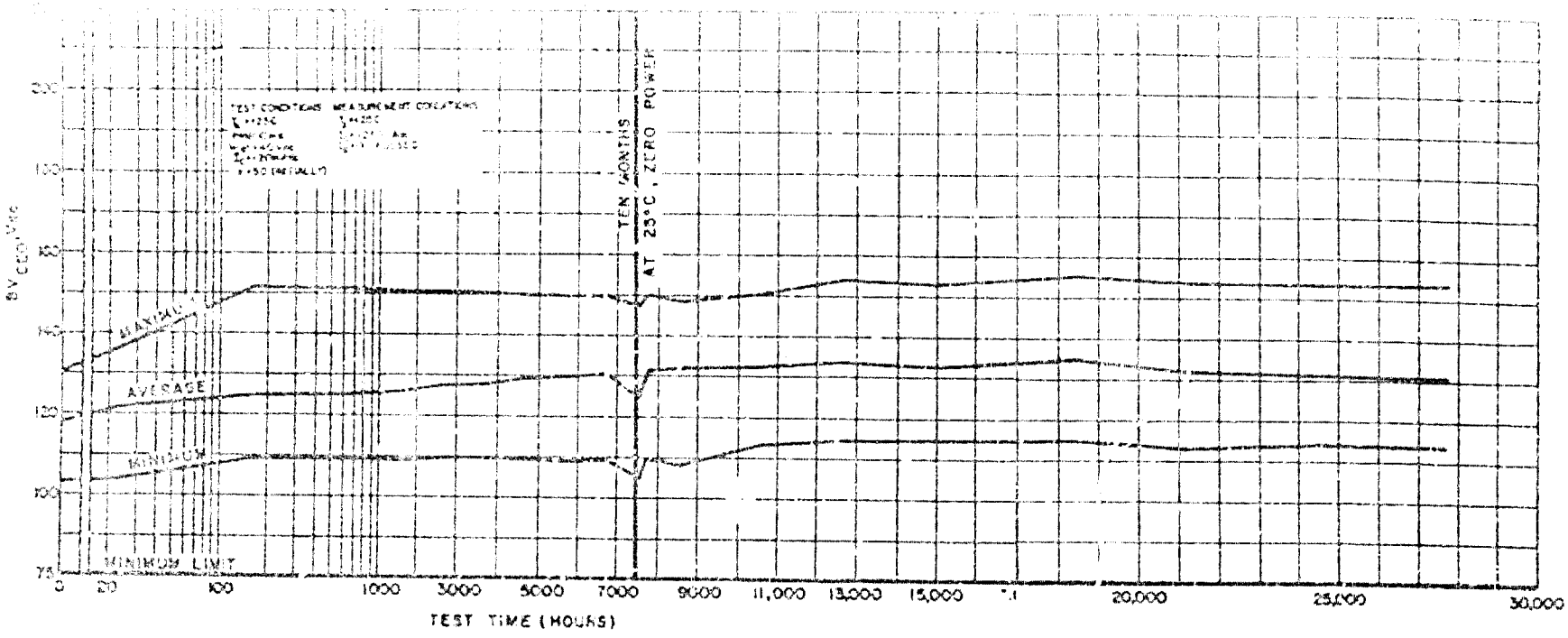
Figure 3-104. Parameter Trend Chart, R2050P1, Ambient Life, BV_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	9.915	0.519	8.053	10.686
24.	10.067	0.475	7.590	10.699
168.	9.759	0.741	6.642	10.695
672.	9.729	0.717	6.632	10.572
1496.	9.741	0.727	6.890	10.908
2016.	9.741	0.749	6.830	10.885
3692.	9.718	0.722	6.451	10.698
4374.	9.729	0.719	6.879	10.951
5064.	9.744	0.737	6.953	10.895
6744.	9.731	0.713	6.872	10.972
7458.	9.733	0.729	6.893	10.969
8184.	9.730	0.731	6.869	10.599
9528.	9.736	0.713	6.876	10.527
11521.	9.751	0.718	6.887	10.593
12879.	9.754	0.713	6.886	10.596
14365.	9.750	0.709	6.911	10.591
16456.	9.751	0.719	6.931	10.592
21466.	9.744	0.716	6.931	10.589
24144.	9.739	0.711	6.895	10.583
47664.	9.737	0.711	6.906	10.580

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
0	1464 HOURS	1
		1

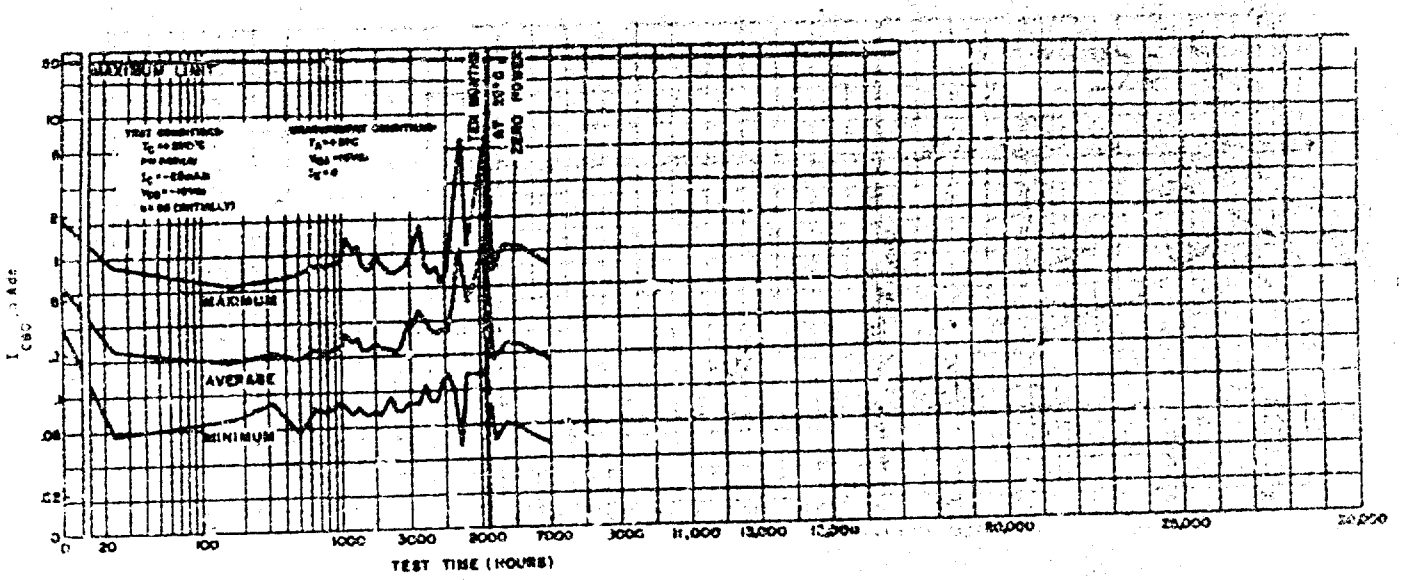
Figure 3-105. Parameter Trend Chart, R2050P1, Ambient Life, BV_{EBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0	117.634	9.035	103.000	146.000
24	121.937	9.914	104.000	134.000
168	124.690	9.959	109.000	131.305
672	125.051	9.270	109.000	15[illegible]
1008	126.279	8.392	108.000	[illegible]
2520	127.296	8.769	109.300	[illegible]
3192	128.559	7.269	109.300	53[illegible]
4032	129.543	7.761	109.400	149.000
5880	130.169	8.138	108.900	147.000
6888	130.698	8.439	109.100	148.500
7056	124.719	7.837	105.300	147.900
7728	131.247	8.472	109.900	149.900
8568	127.283	7.998	108.400	146.200
10248	132.833	8.407	112.800	150.100
10920	133.567	8.741	114.500	154.100
11592	132.351	8.282	114.900	153.800
11928	134.971	9.133	115.400	156.300
12432	131.585	10.231	112.900	153.600
12936	133.867	10.268	112.900	153.300
13272	132.253	10.328	113.400	153.100

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
2	1996	1
	2992	1

Figure 3-106. Parameter Trend Chart, R2950P1, Ambient Life, BV_{CFO}



R4041
Phase 4
ICBO

Item	Average	Minimum	Maximum	Std. Dev.
0	.094	.340	1.980	0.339
24	.209	.052	.880	0.290
168	.171	.068	.620	0.201
329	.196	.086	.640	0.208
497	.172	.052	.738	0.242
664	.209	.078	.865	0.280
784	.199	.072	.810	0.271
1008	.215	.085	.990	0.298
1182	.244	.078	1.380	0.436
1350	.251	.074	1.070	0.365
1518	.262	.077	1.18	0.378
1694	.193	.058	.810	0.274
1856	.200	.069	.[illegible]	0.252
2022	.228	.073	.[illegible]	0.330
2190	.207	.068	.895	0.288
2413	.203	.098	.763	0.239
2581	.186	.074	.780	0.229
2749	.226	.070	.795	0.267
2921	.299	.080	.84	0.341
3089	.301	.082	1.18	0.376
3253	.383	.084	1.57	0.539
3416	.312	.110	.[illegible]	0.[illegible]
3589	.276	.085	.72	0.268
3757	.252	.063	.76	0.285
3925	.276	.110	.62	0.[illegible]
4093	.267	.130	.705	0.215
4261	.436	.108	2.16	0.738
4429	1.039	.048	6.6	2.374
4687	.410	.130	1.100	0.417
5213	1.735	0.138	8.108	2.784
5388	0.165	0.062	0.720	0.251
5710	0.316	0.036	1.160	0.358
6207	0.301	0.032	1.050	0.344
6864	0.168	0.060	0.848	0.273

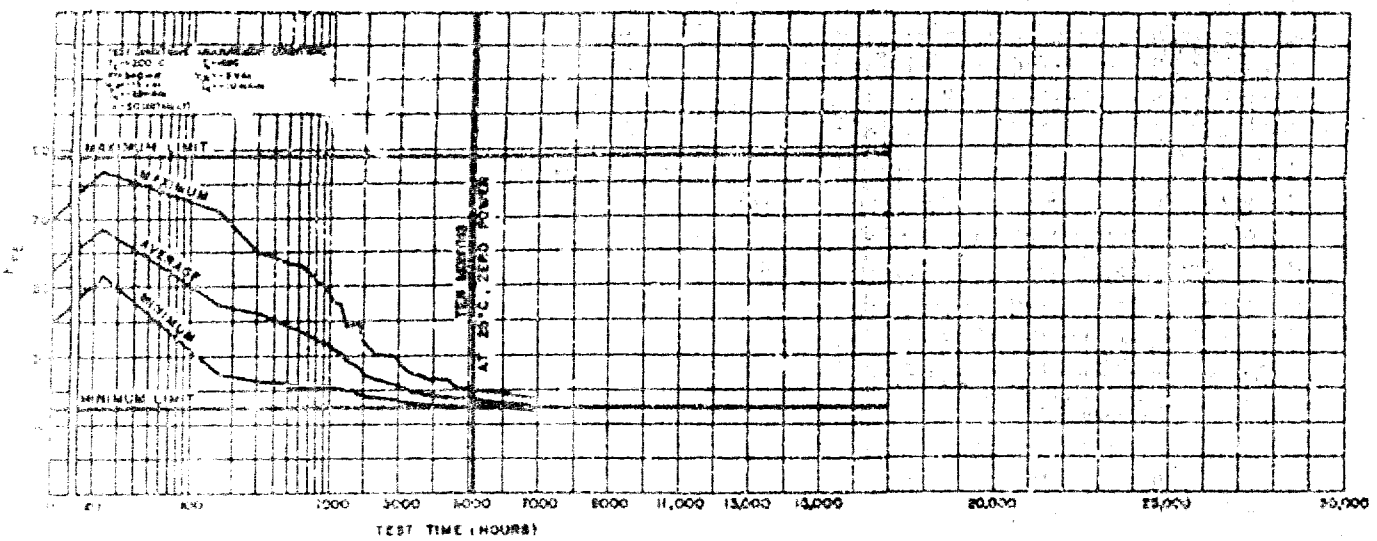
TOTAL FAILURES

46

TIME TO FAILURE (hrs)

QUANTITY

Figure 3-107. Parameter Trend Chart, R4041P1, Phase IV. I_{CBO}

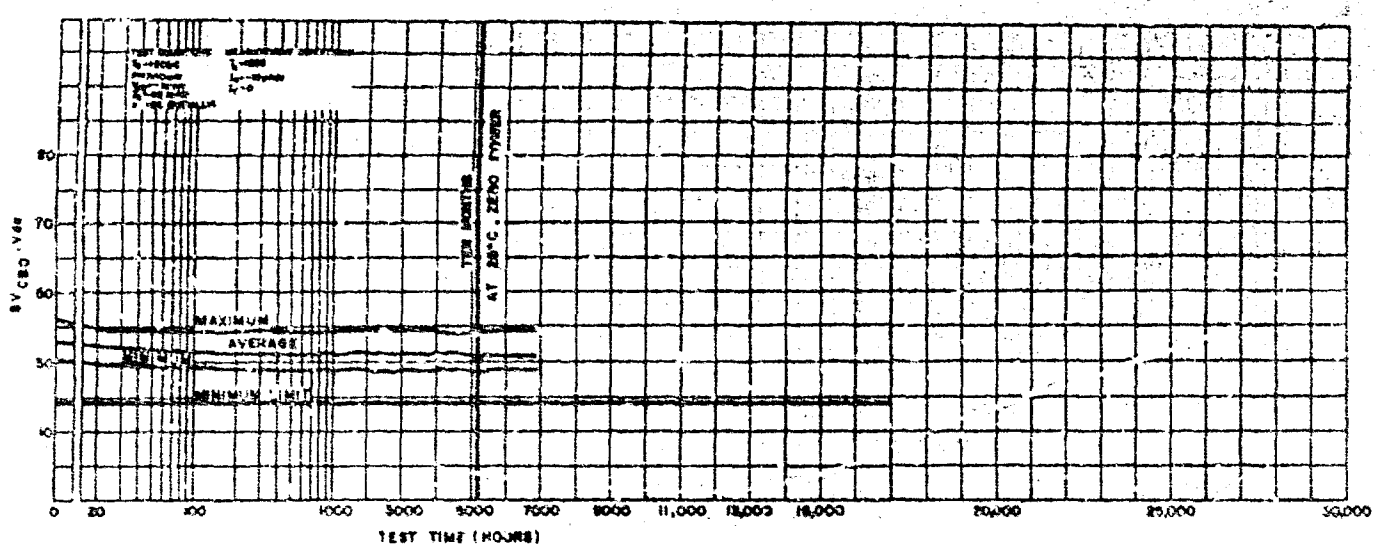


R4041 P1
Phase IV
h_{FE}

Test Hours	Average	Minimum	Maximum
0	54.214	48.484	60.970
44	49.159	39.478	64.000
190	48.957	40.974	71.000
369	48.271	40.588	69.484
697	49.957	43.549	67.196
844	49.567	41.000	64.000
1144	48.840	41.196	65.000
1336	46.667	41.196	60.750
1512	41.969	34.750	48.000
1744	40.571	34.196	44.000
1919	44.667	34.950	52.000
1968	47.987	38.000	58.000
1864	48.586	40.000	56.750
2024	54.864	46.196	64.750
2136	52.956	46.000	60.000
2416	53.000	48.000	59.250
2661	52.679	47.500	57.000
2760	50.136	47.000	54.000
2921	52.464	47.000	58.954
3000	50.179	45.000	57.000
3261	50.000	46.000	54.000
3416	48.357	40.196	54.954
3648	48.971	42.000	54.000
3747	48.714	44.000	53.000
3828	48.964	45.000	50.000
4048	49.179	44.000	53.000
4451	48.071	46.000	50.000
4625	48.000	45.000	51.000
4847	47.679	44.000	51.000
5010	48.000	48.000	49.000
5300	47.500	45.000	49.000
5713	47.036	44.500	49.000
5867	47.000	45.000	48.000
6066	47.500	46.000	49.000

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
44	44	1
	140	1
	190	1
	697	1
	844	1
	968	1
	1144	1
	1196	1
	1344	1
	1512	1
	1697	1
	1744	1
	1968	1
	2024	1
	2136	1
	2416	1
	2661	1
	2760	1
	2921	1
	3000	1
	3261	1
	3416	1
	3648	1
	3747	1
	3828	1
	4048	1
	4451	1
	4625	1
	4847	1
	5010	1

Figure 3-108. Parameter Trend Chart, R4041P1, Phase IV, h_{FE}



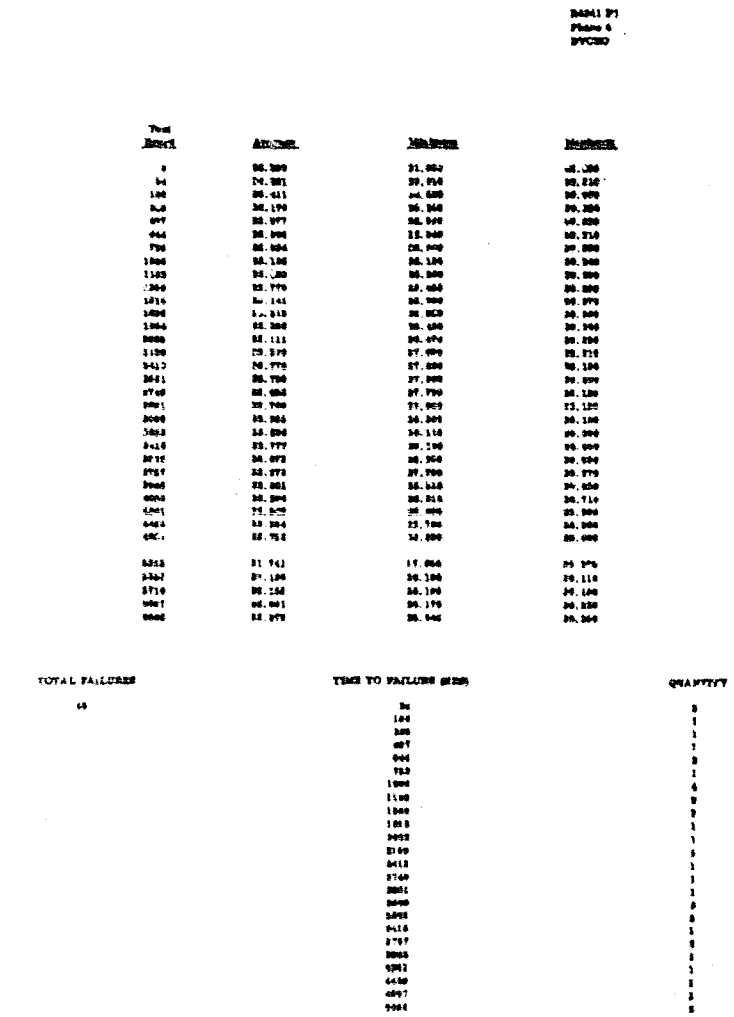


Figure 3-109. Parameter Trend Chart, R4041P1, Phase IV, BV_{CBO}

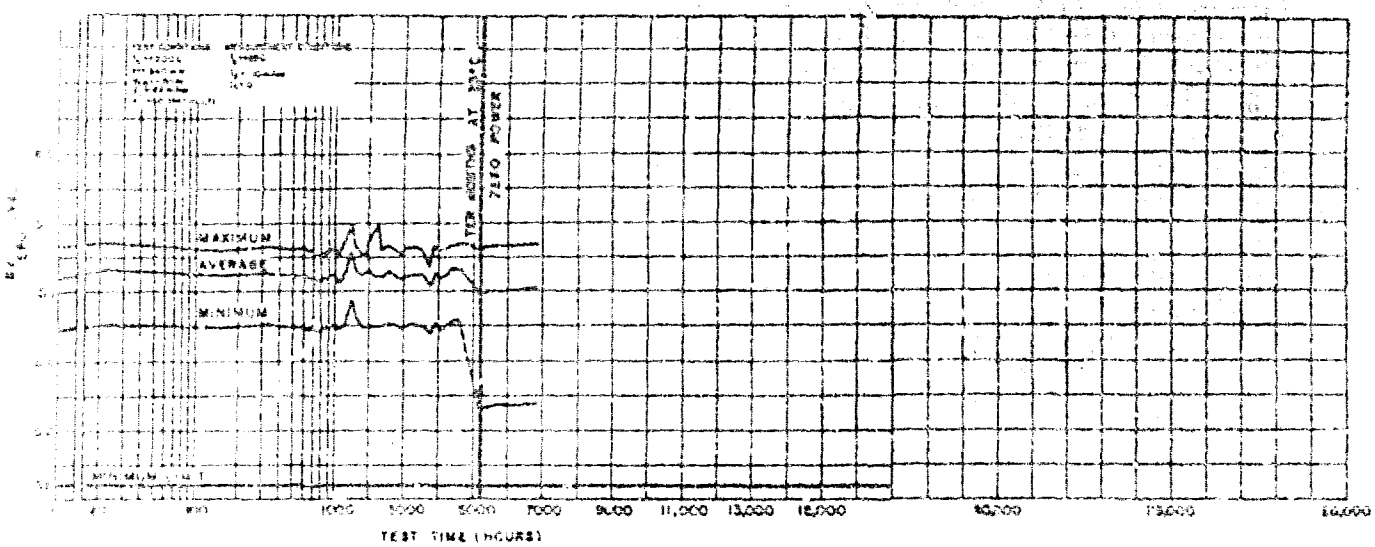


Figure 3-110. Parameter Trend Chart, R4040 P1, Mean IV, BV$_{EBO}$

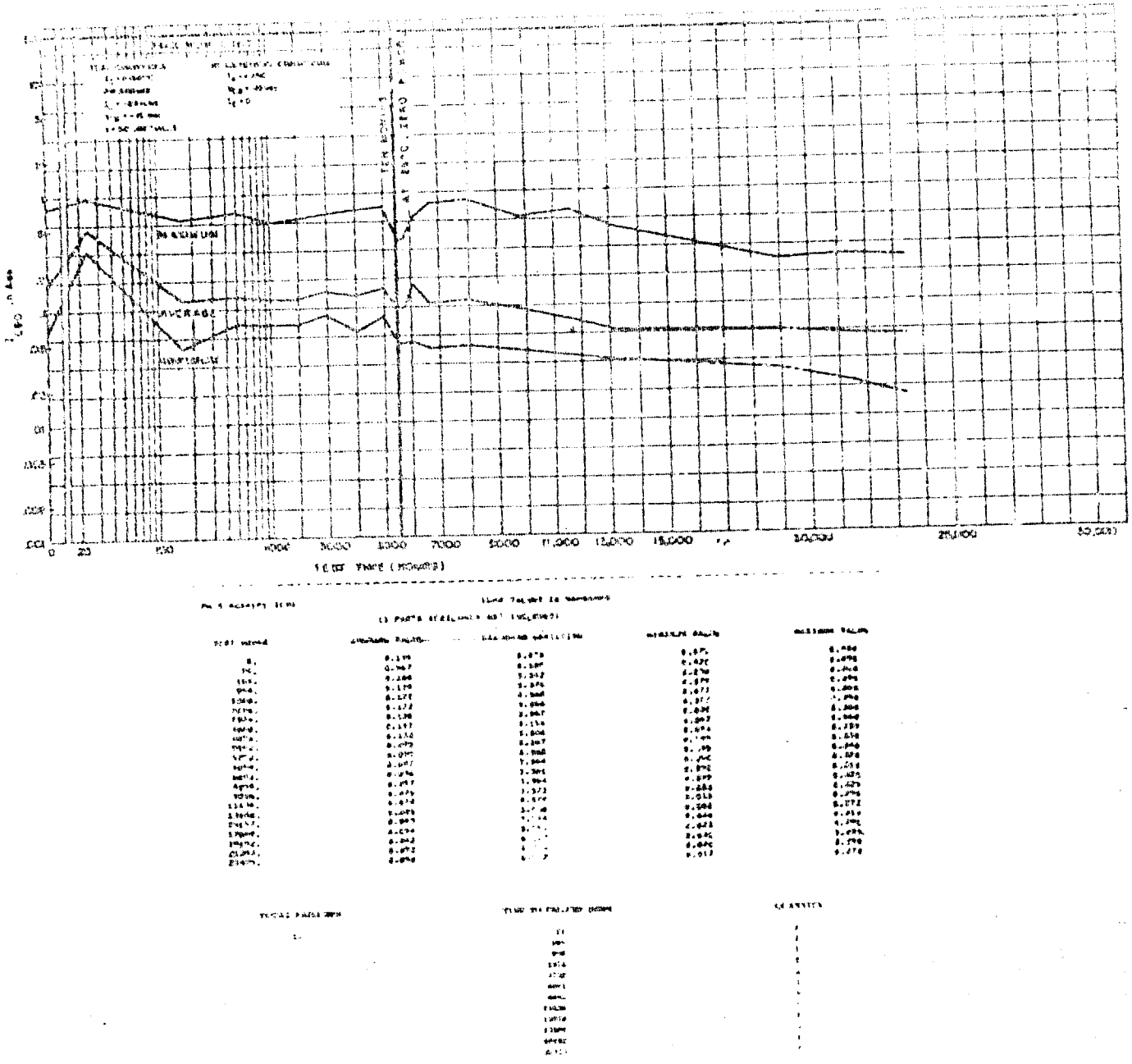
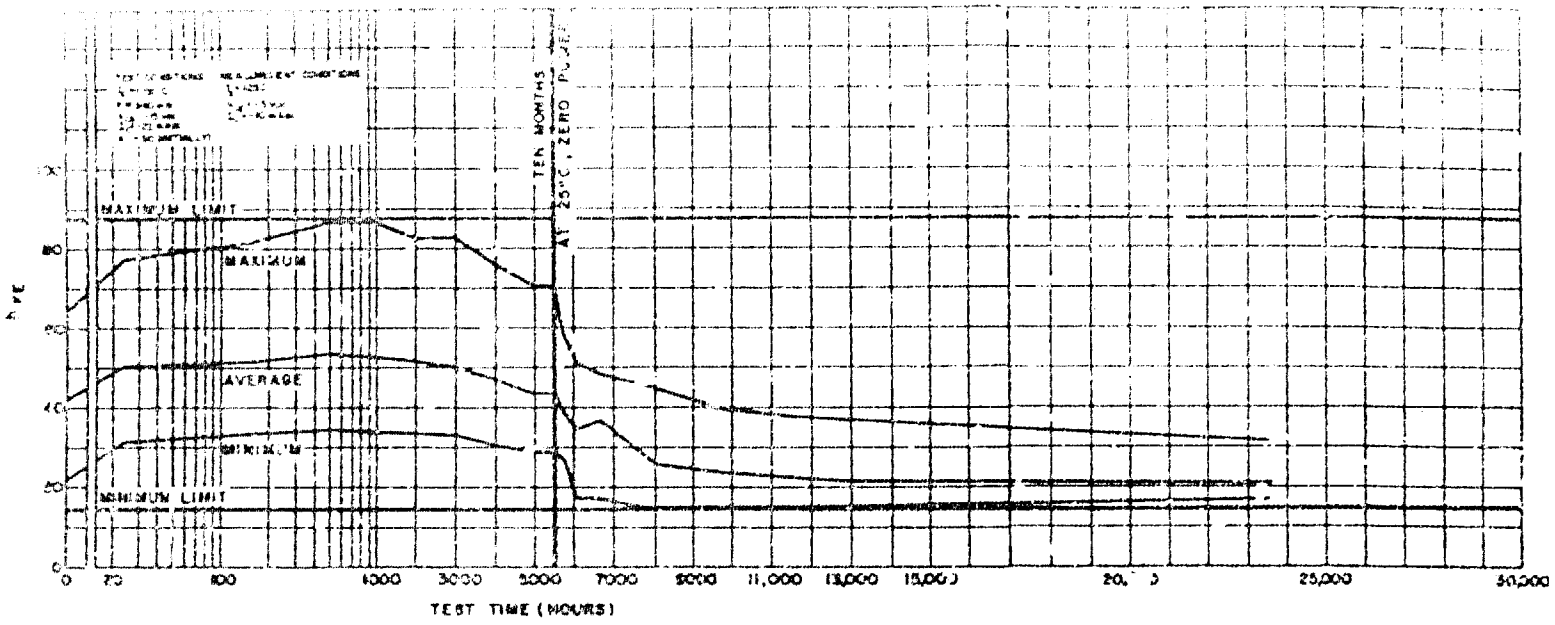


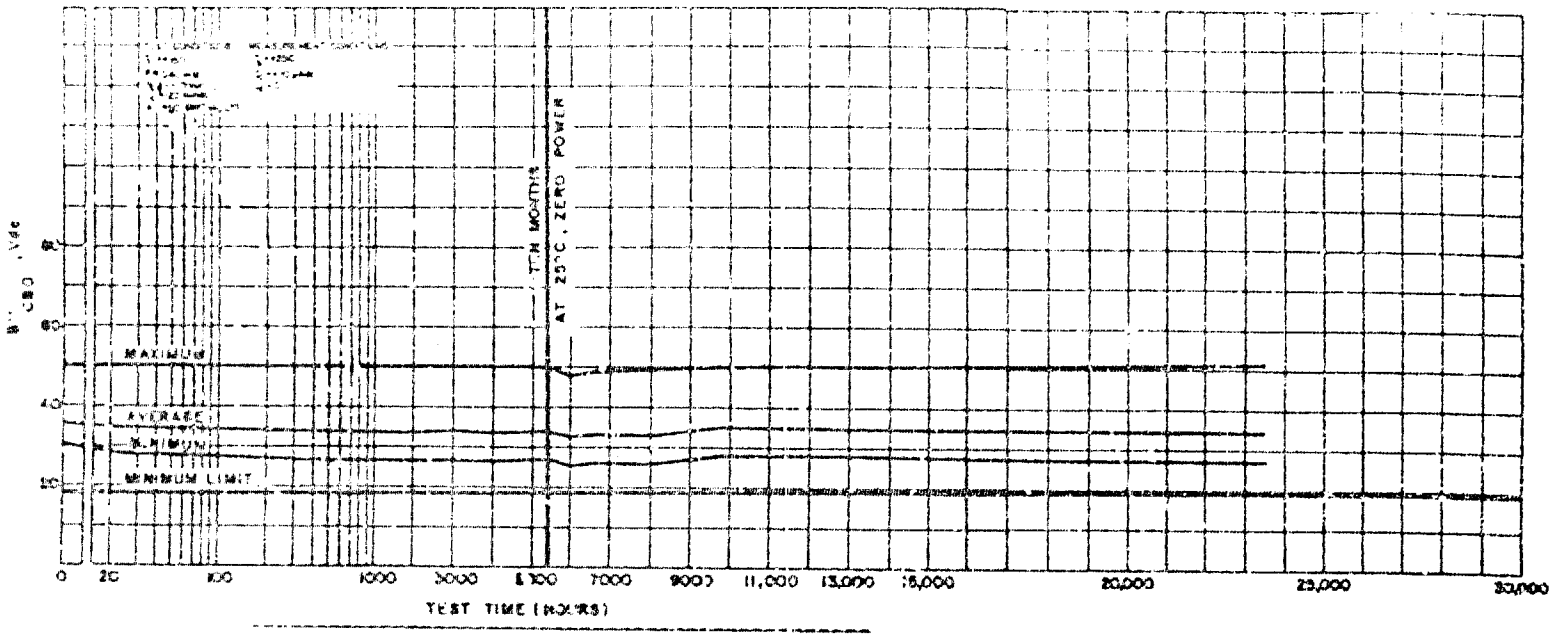
Figure 3-111. Parameter Trend Chart, R4041P1, Phase V, I_{CBO}



TEST HOURS	AVERAGE VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
0.	42.546	9.136	29.863	64.196
24.	52.787	11.363	39.263	77.568
168.	56.863	12.458	38.563	82.888
504.	57.746	13.916	34.296	87.896
1016.	53.256	14.236	38.286	87.686
2016.	55.873	15.897	30.896	83.481
3024.	54.598	15.666	30.869	84.466
4032.	56.456	12.751	38.156	76.378
4976.	54.779	11.878	31.866	76.868
5992.	47.633	12.891	31.166	71.868
6752.	48.663	8.986	34.496	66.861
6841.	34.926	6.586	24.963	51.861
6921.	35.886	7.157	25.896	48.966
6996.	36.446	9.131	17.496	46.486
7128.	36.826	7.665	18.268	46.866
11184.	29.267	7.675	17.868	36.868
15696.	24.342	6.2 6	12.868	31.866
15997.	26.367	5.763	17.896	35.896
17p19.	23.646	6.269	16.896	34.666
19176.	23.233	7.616	10.566	32.766
21368.	26.673	5.665	19.966	32.966
23479.	24.187	5.361	19.496	29.986

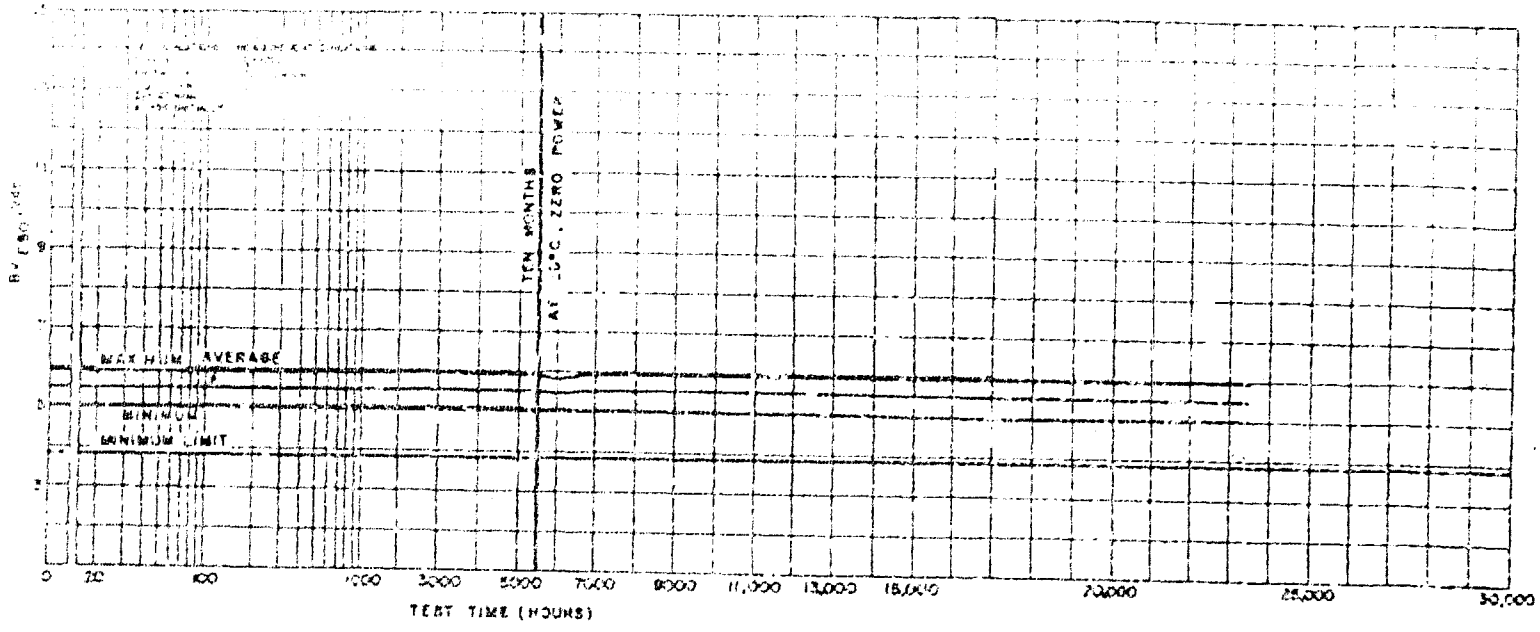
TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
25	24	1
	168	1
	504	1
	2016	1
	3792	2
	6984	2
	7662	1
	11376	2
	15696	1
	17496	1
	19152	1
	23496	1

Figure 3-112. Parameter Trend Chart, R4041P1, Phase V, h_{FE}



TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
31	34	1
	138	1
	148	1
	2874	1
	3152	1
	4684	2
	8082	6
	11615	2
	13078	1
	17980	4
	19192	1
	29435	1

Figure 3-113. Parameter Trend Chart, R4041P1, Phase V, BV_{CBO}



TEST HOURS				
0				
20				
100				
1000				
3000				
5000				
7000				
9000				
11,000				
13,000				
15,000				
20,000				
25,000				
30,000				

TOTAL FAILURES	TIME TO FAILURE (HRS)	QUANTITY
25	20	1
	156	1
	169	1
	2516	1
	5163	1
	8146	3
	9483	2
	11836	4
	13878	1
	17899	4
	19143	1
	29426	1

Figure 3-114. Parameter Trend Chart, B4041P1, Phase V, BV_{EBO}

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
General Electric Co.
King of Prussia, Pa.

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
N/A

3. REPORT TITLE
ACCELERATED TESTING OF HIGH RELIABILITY PARTS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Technical Documentary Report

5. AUTHOR(S) (Last name, first name, initial)
T. Walsh
G. Best

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
June 1967	358	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
AF30(602)-3968	
b. PROJECT NO. 5519	N/A
c. Task No. 551902	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	RADC-TR-67-71 Vols. I and II

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13. ABSTRACT
This is the final report on Contract AF30(602)-3968. Long term tests to 30,000 hours were continued to provide correlation data for accelerated test results. A theory of life governing processes for electronic parts is given. The data is analyzed and presented to provide estimates of the life governing processes for each part type. A physics of failure study of mica, ceramic, porcelain, and glass capacitors was also performed and the results are included.

DD FORM 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Accelerated Testing Step-Stress Failure Mechanisms Degradation Models						

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